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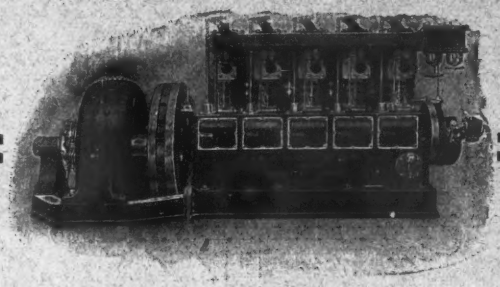
Advertisement Index, see page xxiv.



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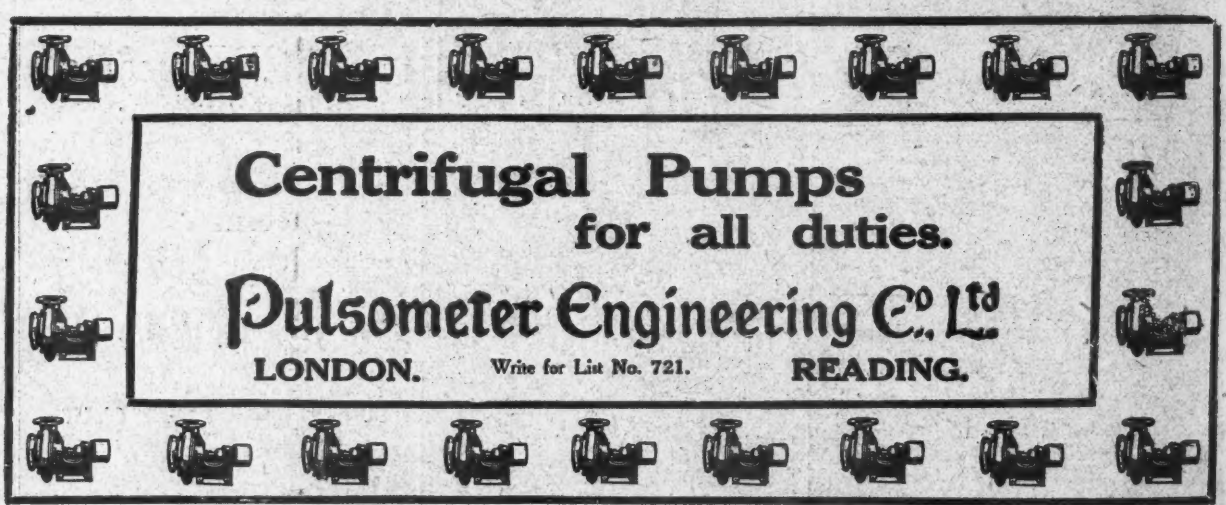

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THE

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Vol. LXXIX.] CONTENTS: November 3, 1916. [No. 2,032.

	Page
On Maximum Efficiency	477
The Future of Japanese Electrical Industry	478
Construction Contracts and the War	479
The Present Position of Electroculture	479
A New Universal Shunt, by H. W. Brown (*illus.*)	480
Electric Vehicle Development	480
Powdered Coal as a Fuel (*illus.*)	481
Burning Coke Breeze (*illus.*)	483
New Electrical Devices, Fittings and Plant (*illus.*)	484
Willans Surface-Condenser Tests (*illus.*)	485
Legal	485
Correspondence—	
Electrical Market in India	487
Cost of Daylight *v.* Electric Light	487
War Items	487
Business Notes	488
Notes	492
City Notes	495
Stocks and Shares	498
The Use of Ionised Air in Agriculture, by I. Jorgensen (*illus.*) (*concluded*)	499
The Institution of Electrical Engineers	501
Diesel Engine Users' Association	502
Trade Statistics of the Straits Settlements	503
Foreign and Colonial Tariffs on Electrical Goods	503
New Patents Applied for, 1916	504
Abstracts of Published Specifications	504
Contractors' Column	Advertisement page xx

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THE UNIVERSAL ELECTRICAL DIRECTORY

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1916 EDITION.

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ON MAXIMUM EFFICIENCY.

UNDER the stress of the present unprecedented emergency our national life is being shaken up from top to bottom. Not only does the situation increasingly demand that every man and woman shall be in that position where they can contribute the right kind of service to the Allied effort for the successful prosecution of the war; it equally demands that when we have found our right place we shall contribute the utmost that lies within our power of that right kind of service. We need not refer to the part that is being contributed by the actual fighting forces, nor to those who behind the lines or at the base are rendering non-combatant service of different kinds; we do not pretend to be in a position to say whether the places of the latter could be filled with equal effectiveness by others while some of these are released for actual fighting, for the point lies beyond our particular scope. But we are directly concerned in the efficient utilisation of the non-combatant forces at home.

Two events of the past week have again brought very emphatically to mind the importance of every worker and every machine being utilised in such a place and in such a way as to contribute maximum efficiency. There is no room for either idle men or idle machinery to-day; the principal difficulty in the way of securing the maximum from all lies in the reconciliation of the different interests which contribute to the success of our Arms. It has been one of our great problems ever since the demands for men and munitions first began to reach unexpected dimensions, but to-day the problem is more acute than it has been at any previous stage of the war, and readjustment of our national resources demands of us all that we shall be prepared to seriously consider our own personal relation to the world-conflict, whether we are masters or men, whether we are professional classes or workmen, whether we are brain-workers or tradesmen, technical, commercial, or clerical. Personal interests are to be subordinated to national, whether we like it or not, and the only door at which we can fairly lay the blame is that of those who aimed at the Prussian Domination of the World. We agree absolutely with the Army Council in its very definite conviction that this is a young man's war, and we believe that it has the great bulk of the nation behind it in its efforts to secure the right men for the fighting line by drawing off the millions from work which can be performed by others. But we believe that this process would be more easily carried through if every worker recognised the pressing need for him to do his best work when he has found out what that work is. Mr. Asquith told the representatives of the coal-mining industry that by abandoning what is euphemistically called avoidable "absenteeism" we could increase our coal output by 15,000,000 tons per annum. Coal is one of the vital factors in the war, necessary for the Fleet, for the mercantile marine which brings in our food, for the tens of thousands of factories making munitions and manufactured exports; it is a vital necessity for our Allies, and its exportation to them is essential on financial grounds. But those requirements cannot all be properly met because there is 5 per cent. avoidable "absenteeism." Situated here, at the hub of things, and eagerly following each development of the war from day to day, we ordinary mortals may think that it should only re-

quire every colliery worker to be apprised of the fact for him conscientiously to examine himself and solemnly resolve that, inasmuch as he believed in the righteousness of the Allied cause and wished his children never to come under the terrible heel of the Hun, he would produce more coal per hour than ever before from now until the end of the war. We trust that the representatives of the men who gave Mr. Asquith an undertaking will be able to secure the hearty co-operation of the men themselves.

But is it only to workers in the collieries of the land that the urgent counsel to abandon avoidable "absenteeism" should come? Are there not some other departments of essential activity in which the same warning should be given for the sake of the allied cause? Are there not many of us in many vocations who, by only a slightly increased effort, could increase our individual production, and so release part of a worker for something else? We need not particularise, but there are still forces or influences at work amongst us which stand in the way of a general contribution of maximum efficiency all round. And the things that hinder must be put aside, whatever they be, if the emergency is as great as our advisers represent it to be. The Ministry of Munitions and the Military authorities are exercising their powers by searchingly scrutinising our industries and our occupations, and the Board of Trade decides what may or may not be imported. We certainly cannot afford to have our labour, our ships, our railways, and our factories occupied with things that we can do without, and we shall be little the worse if we put hindrances in the way of those who want to spend recklessly their unaccustomed riches, or if we generally simplify our standard of requirements for the period of the war. Measures to these ends may not be very pleasing, but we must blame the situation in which the nation stands, when it is still necessary to concentrate all our efforts on securing the defeat of an embittered enemy who finds his cherished ambitions frustrated and his chances of victory almost gone.

Engineers are accustomed to think much of "efficiencies," and they know only too well that neither machinery nor individuals can be expected to produce their maximum output continuously. Overload capacity of machine and man has very definite limits. The experience of the war has taught us many lessons regarding overtime, fatigue, Sunday labour, the importance of rest periods, holidays, and so on, but when these matters have been carefully taken into account in developing our measures, "avoidable absenteeism" on the part of anybody to whom the State is looking to-day for his best is an unpardonable sin. We may be suffering from the physical and mental consequences of war-weariness, but this is no time for lessening our efforts, and we have to utilise the industrial ability of man and machine to the full in order to keep the Forces supplied with munitions, to keep our Allies supplied with coal, and to maintain our financial credit as far as is reasonably possible by exportation of goods and materials which occupy the minimum of labour in proportion to their value.

As part of this matter there is the need for the utilisation of the whole of the suitable machinery that is within these islands. Any machine that is lying idle represents so much waste, if in the hands of the Ministry of Munitions it could be turned to good account for the purposes of the war. Therefore, we cannot but welcome the announcement issued by that Department concerning the mobilisation of idle machinery. It has established a central clearing-house organisation for the purpose of tracing and registering *machinery which is idle or is about to become idle*. It will be the object of the organisation—

(*a*) To ensure that contracts placed by the Ministry are directed towards any unoccupied manufacturing capacity which might exist in the country.

(*b*) To place engineering contractors who have suitable facilities for particular supplies in touch with the Ministry and with other Government departments requiring these supplies, and to help contractors who are able to undertake additional or more suitable work now or at a future date to maintain continuous employment of their machinery and labour.

An invitation is given to manufacturers possessing idle resources and desiring to be placed in touch with Government Contracting Departments to communicate with the Central Clearing House, Ministry of Munitions, 8-9, Northumberland Street, W., when further particulars will be sent to them.

Manufacturers who know the state of the markets of the world, and want to do something to retain their hold on foreign trade, maintaining connections, as far as is reasonable, to serve the national interests, will, we are sure, recognise the need for co-operating with the Ministry of Munitions in this matter. As the financial aspects of the war change as it is more and more prolonged, the importance of exports does not grow less, but we have reached that pass when we must all see that everything in reason should be done to bring the war to an entirely victorious issue at the earliest possible moment. Whatever effort on the part of skilled or unskilled labour the national cause demands it must have, whatever dilution or substitution the situation really demands in order that we may put the best men in the Field, must be accorded, and we must adapt ourselves to the altering conditions as readily and conveniently as we can. But after all the readjustment and all the mobilising, much will still depend upon the efficiency of the individual. Let Labour and Capital, man and machine, all alike give "A long pull; a strong pull; and a pull all together" to bring about the Victory.

The Future of Japanese Electrical Industry.

We have on several occasions referred to the enterprising development of Japanese electrical industry. This enterprise is not a new growth, for there was a full appreciation of electrical possibilities among engineers in Japan before the war; but the condition of affairs consequent upon the state of war has given our alert Ally an opportunity that she was not slow to recognise. The cutting off of German supplies from various world markets led Japanese electrical works to pursue energetically those particular lines of manufacture for which the available labour and supplies of material were most readily adaptable. Manufacturing facilities have been established which might not have been considered necessary so long as Germany was able to send her manufactures abroad pretty well as she pleased. But after the war, what about this manufacturing capacity?—will it have scope when—if ever—Germany resumes her old Hunnish dumping practices in markets for which Japan is now catering? This and other considerations have led electro-industrial authorities to see what steps they must take in order to be prepared for future possibilities, and there, as here, organisation—if need be combination—is found to be one of the main essentials. Industrial banking and credit facilities are other essentials of the situation if Japan is to secure a firm hold in markets where Germany in her past days has exercised those privileges to the utmost of her power. The future financial position of Germany is so uncertain and hazardous a problem that one wonders how far her firms are likely to be able to use the old financial weapon; if we mistake not, that weapon is failing in her hand, and must inevitably do so more and more until the end comes. But whatever happens in respect of Germany, Japan, like ourselves, appreciates the need for better financing arrangements for industry, especially in China where, from all that one hears, the German contract-getting menace is already showing an activity which is remarkable

considering the state of affairs in Europe. The *Japan Weekly Chronicle* quotes from the *Mainichi* some interesting comments on the proposals regarding the future of electrical industry which have been advanced by Mr. Munasuye, the Director of the Electric Bureau in the Department of Communications. This gentleman has several times summoned representatives of the Shibaura, Mitsubishi, Sumitomo, Hidachi, Kuhara, and other manufacturers of electrical machinery and apparatus, and urged upon them the advisability of making a combination to promote their mutual interests. Mr. Munasuye says:—"It is true that since the outbreak of the European war, Japan's export trade in electrical machinery and apparatus has been increasingly satisfactory, but nevertheless it is necessary that measures should be taken to ensure the development of the industry. This object may be attained along the lines of establishing a combination of manufacturers, as has been done in Germany, in order to avoid fratricidal competition among themselves, to unify the industry, and to secure more financial facilities than are possible under the present plan. The manufacturers should not only sell their products, say, in China, but should also undertake installation and all other works necessary for the commencement of electric business. In this case, transactions will be necessarily on long credit, and the manufacturers should get into special relations with bankers." Mr. Munasuye goes on to say that in Germany, bankers accord the most complete facilities to two large combinations of electrical manufacturers, and have thus largely assisted them in realising their world-wide development, and he puts his finger upon a characteristic that has also been touched nearer home when he says: "Japanese manufacturers, however, are too individualistic and not amenable to co-operative combination. This failing should be overcome in order to promote Japan's export trade in electrical machinery and apparatus, and to that end I shall exert myself with further consultation with the leading manufacturers."

Construction Contracts and the War.

A case which illustrates in a remarkable way the effect of the war on contracts of construction was decided recently by Mr. Justice Bray. Some time before August 1st, 1914, Messrs. Dick, Kerr & Co. had undertaken to erect certain waterworks for the Metropolitan Water Board at a cost of £673,000. The contract, it may be presumed, contained the usual clauses vesting material brought on to the site in the employers, and giving power to the employers' engineer to extend the time for completion. The work was discontinued in accordance with an order by the Ministry of Munitions, who also decided that certain plant and materials on the site should be sold, both parts of the order being duly carried out by the contractors. In these circumstances the Metropolitan Water Board brought an action claiming a declaration that the contract was still valid and subsisting; that they were entitled to the plant and tools on the site in so far as they had not been sold pursuant to the above order; and that as to the tools, &c., sold, the contractors were bound to account to the Board. Mr. Justice Bray held that the order of the Ministry not having made the performance of the contract illegal or commercially impossible, having regard to the engineer's power to extend the time, the plaintiffs were entitled to a declaration to this effect. He also held that they were entitled to the tools, &c., on the site but that the defendants need not account to them for the tools sold.

It would seem that the result of this decision is that when that dim and distant epoch "after the war" commences, Messrs. Dick, Kerr & Co. must needs collect their scattered workmen and carry out this formidable contract. It is to be observed, however, that the engineer having, by operation of law, been forced to extend the time, he will also be compelled (if the contract is drawn upon customary lines) to make due allowance to the contractors for the altered conditions which must obtain when work is resumed. Such, at any rate, would probably be the result of a forced suspension of a building contract drawn in the form sanctioned by the Royal Institute of British Architects, clause 25 of which provides that: "If in the opinion of the architect the works be delayed by *force majeure* . . . . the architect shall make a fair and reasonable extension of time for completion in respect thereof." We say "probably" because even that elaborate form of contract makes no provision for alteration of schedule prices in the event of delay. But it could be argued with great force that by reason of the enforced delay, and as a direct consequence of the intervention of the Ministry of Munitions, the whole substratum of the contract was altered, and that in law, as well as in equity, the basis of remuneration must be changed. We anticipate that when the war comes to an end the time of the judges will be fully occupied in considering questions of this kind.

The Present Position of Electroculture.

In the present issue we publish the conclusion of an article on the use of ionised air in agriculture by Mr. Ingvar Jorgensen, who has for some years devoted considerable attention to the investigation of the subject.

If Mr. Jorgensen's brief survey does nothing else, it at least indicates that great possibilities lie ahead of a thorough investigation of the subject, which in common with a good many other branches of scientific research has been neglected in the past.

Previous to the war, some half-dozen experimental areas were in use in England and Scotland, but none of these, so far as we are aware, were regarded as really of sufficient extent to justify commercial conclusions being drawn from the results obtained.

The results, in themselves, appear to be most promising, the experimental electrification of growing oats, by Miss Dudgeon in 1915, resulting in an increase of grain by 30 per cent., and of straw by 58 per cent., while this year, we understand that even these increases have been doubled—the value of the extra crop so obtained being about £6 per acre. When it is remembered that an installation of the most recent type indicated in the article should not cost more than, say, £100 for 20 acres. it will be conceded that there is a very profitable side to the question.

The recent report by Mr. Middleton of the Board of Agriculture, on the comparative position of German and British agriculture, contained a recommendation that the farmer should be induced to "speed the plough" if greater productiveness of the soil was essential to our well-being. This—shall we say—old-fashioned advice may in the near future give way, in favour of the more scientific, recommendation to adopt electroculture.

It is the usually accepted idea that, the apparatus required for electrical discharge purposes is too costly for the farmer, and in any event too intricate for him to handle.

While there may be some truth in the latter suggestion, it can scarcely be contended that the cost, in view of what the farmer is prepared to spend on motor ploughs and tractors, is prohibitive; moreover, we understand that efforts are now being directed to the production of simple, robust, and less costly apparatus specially designed for farm use.

A NEW UNIVERSAL SHUNT.

By HARRY W. BROWN.

The accompanying sketch of a new type of shunt which I have designed will, I think, interest your readers. Figs. 1 and 2 show the principle and development of it. The principle of it is based on the Wheatstone bridge, as shown in fig. 1. Suppose A, B, C, and D are stretched resistance wires of equal lengths and of uniform and equal resistance,

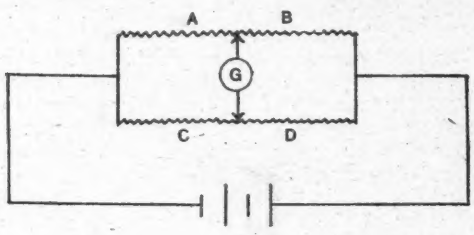


Fig. 1.

then if the galvanometer leads are moved together, either to the right or left, there will be no deflection on the galvanometer, because A : B : : C : D.

Now in fig. 2 such is not the case, as there is only one neutral point, which is at the centre; moving the galvano-

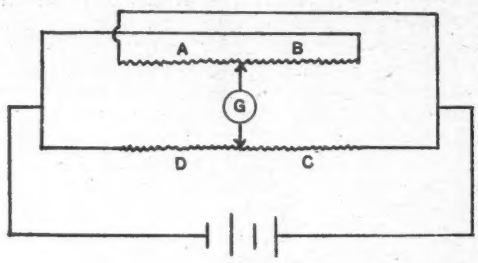


Fig. 2.

meter leads, either to the right or left, will cause a deflection, and this deflection will be increased until the leads reach either extreme. This is due to the cross-connecting of the coils.

Fig. 3 shows the shunt complete, with the exception of the movable switch connecting the respective segments to

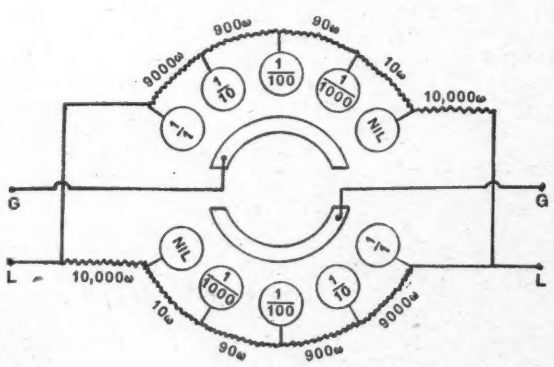


Fig. 3.

their various contact studs. This galvanometer switch will, of course, be double-pole, actuated with one handle. The advantages of this shunt are, first, that the only moving contacts are in the galvanometer circuit; secondly, that the main current is kept constant, no matter what shunt is being used. This shunt-box can be used with any galvanometer, and I think that it can be rightly called a constant-current universal shunt.

ELECTRIC VEHICLE DEVELOPMENT.

A Definite Policy in Vienna.

Sufficient devotion to the development of electric vehicles has hardly figured amongst our achievements of the past two years, but the latest petrol restrictions have compelled attention to the advantages and possibilities of the "electric," the manufacture of which in this country certainly deserves to rank amongst those industries second only to munitions. The enemy has been entirely dependent on internal sources of supply for motor fuel. From these sources immense quantities of benzol and alcohol have been obtained, but the electric vehicle, which can store and utilise energy derived from central stations, has been utilised extensively in its own particular fields of application. According to the *E.T.Z.*, the German and Austrian estimate of the useful limits of electric vehicles corresponds to a journey of 50 miles at 15 to 19 m.p.h. on a single charge, assuming level roads in good condition. This applies to service in and near towns, and covers commercial and industrial vehicles to an even greater extent than private cars. Evidence of lively interest in the development of the electric vehicle in this class of work is to be found in a motion brought before the Vienna City Council a few months ago to the following effect:—"The war, which has changed the standard of practice and economy in so many directions, can, and must, also effect reforms in automobile traffic within the town. At present most of our petrol cars are being used by the military in the war area, and they should not return in their former numbers to contaminate the city air. Vienna has electricity works and an overland station at Zillingsdorf, equipped and operated on the most modern lines, so that there is no excuse for conveying persons and goods within the city and its suburbs by other than electrical means. By erecting charging stations at tramway termini, in garages, and at other selected points, it will be possible to use electric vehicles in a zone extending at least 12½ miles beyond the city boundaries, particularly if Austrian manufacturers will adopt a standard type and size of battery, so that exhausted batteries may simply be exchanged for charged batteries at charging stations. The city would benefit by the cleanliness, smooth running, and safety of electric vehicles, which are smaller, lighter, and of better appearance than petrol cars, besides being cheaper to operate. It is recommended that no more licences be granted to petrol cars for service in the city area, fresh licences being granted only where cars are to be used in long-distance work. Simultaneously with the adoption of this policy, a sufficient number of charging and battery-changing stations must be erected, and manufacturers of cars and batteries must be persuaded to arrange for the use of standard battery units. Finally, the municipal electricity station is to report to the Town Council on the practicability of the contemplated charging stations and on the general and economic advantages of electric road vehicles."

The principal points to be borne in mind when estimating the importance of the definite and progressive policy adopted in this matter by the Viennese authorities, are the bearing of electrical vehicles on national economy, on central-station development, and on public health. In German and Austria (as in this country) large sums have been placed annually to the national debit by importing petrol. The total energy consumption of automobiles is now so considerable that, to provide it wholly, or in part, from native sources (*e.g.*, from coal-fired or hydro-electric central stations), has quite an appreciable effect on national credit and the rate of exchange. As frequently pointed out in these columns, electric vehicles represent an admirable "off-peak" load for central stations, and their extensive use is bound to reduce the average price of energy and lead to all-round benefit to supply undertaking and consumer alike. The superiority of electric over petrol cars from the hygienic point of view is obvious.

The number of electric vehicles now in use in America is variously estimated at between 80,000 and 100,000. At any rate, the number is enormously, and quite disproportionately, in excess of the number used in Europe, and it is

interesting to note that private electric cars greatly outnumber commercial vehicles in the States; due, doubtless, to the fact that most private cars are used in and near cities in America, whereas the shorter distance between towns in Europe encourages touring. A German estimate of the number of electrics in Europe, at the end of 1914, *i.e.*, practically the latest pre-war figures, shows 3,172 vehicles, distributed as follows:—

Germany, 1,691; France, 318; England, 288; Austria-Hungary, 265; Italy, 238; Switzerland, 200; Holland, 115; Denmark, Sweden, Russia, Belgium, Roumania and Spain together, 57. These figures include electric 'buses and 366 three-wheelers, and are, roughly, equally divided between passenger and commercial vehicles. The applications of the commercial vehicles include transport of goods and materials, fire-engines and escapes, street-cleaning and refuse-collecting, hospital and postal service, &c. There has been a marked increase in the number of heavy electric vehicles in use in this country during the past few years, and an even greater increase in the number of light electrics for delivery service in town and surburban areas. About 700 electric vehicles are now in service in this country, and conditions are very favourable for phenomenal development in the immediate future, if only a vigorous policy is adopted by central stations and manufacturers. There is no longer any possible justification for hesitancy. At the beginning of 1914, there were some 52,000 electrics in use in the United States (18,000 being commercial vehicles), consuming energy to the value of £1,520,000 per annum, and the hope was expressed at a meeting of the National Electric Light Association that there would be 10 million electrics in the States by 1924. That this figure should be reached is hardly possible; but the number of American electric vehicles has, roughly, doubled during the past two years, and there is every probability that future development will be more rapid. In any event, the electric vehicle is certain to be a powerful factor in central-station development, whilst its effect on public health is far from being a mere "talking point."

POWDERED COAL AS A FUEL.

From time to time we have referred in these columns to the use of powdered coal for boiler firing. Up to the present but little real practical work has been accomplished in this direction, but its use for metallurgical furnace heating and cement burning appears to have made considerable progress in the United States. The only steam-raising powdered fuel plant which has made any progress in this country, so far as we are aware, is the Bettington boiler and apparatus, which has been described in our columns.

In the past it was not appreciated that the coal had to burn while floating in the air in the form of dust, and although it was soon found that a flame of intense heat could be obtained, this led to difficulties in connection with the melting down of furnace linings. A paper recently read before the Mining and Metallurgical Section of the *Journal* of the Franklin Institute, by Mr. C. J. Gadd, which discussed modern metallurgical practice as regards the burning of powdered fuel, pointed out that it is the best method of obtaining perfect chemical combination of the air and coal, and enables the highest degree of perfection in combustion to be obtained; its control, however, requires great precision.

Mr. Gadd mentions as essential features (1) that the coal should have a high volatile content, low in ash, (2) that after pulverising, the moisture in the fuel should not exceed three-fourths of 1 per cent., (3) that it be pulverised so that at least 95 per cent. will pass through a 100-mesh sieve and over 83 per cent. through a 200-mesh sieve, (4) that the delivery of the coal to the furnace be uniformly controlled, regardless of the quantity required, (5) that it be delivered in a thoroughly atomised state, and that combustion be completed while the coal is in suspension, and (6) that in the application of this fuel the personal equation be eliminated as far as possible.

Powdered coal fuel requires the use of efficient crushing, drying, pulverising, conveying, and distributing equipment, and ample storage room for coarse coal.

In a paper touching generally on the use of powdered coal fuel, read by Mr. Joseph Harrington before the American Society of Mechanical Engineers in May, the author, referring to objections and difficulties, points out that early experimenters did not appreciate the necessity for fine grinding, nor the influence of furnace design upon the temperature of the resulting gases. The blow-pipe effect of the high-velocity jet melted the brickwork on which it impinged; a layer of melted lava—fused ash and brick—accumulated in the bottom of the combustion chamber. Later on difficulty arose from the minute particles of liquid slag carried in suspension and deposited upon the water tubes, &c., thus closing up flame space and putting the boiler out of action.

On the other hand, Mr. Harrington points out that only in the case of powdered coal is the actual solid fuel both

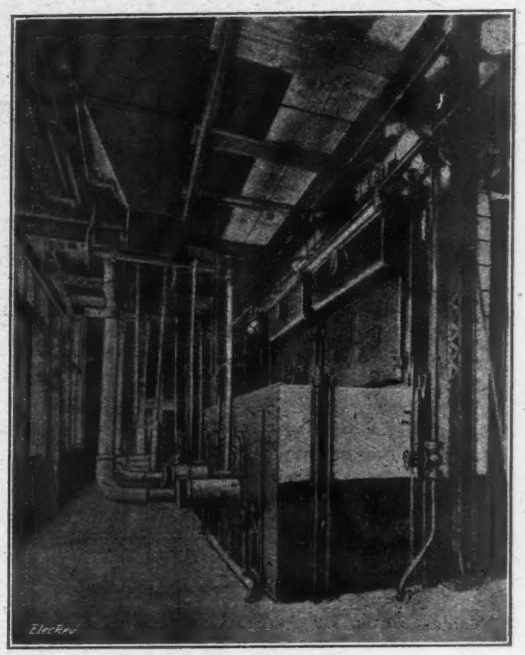


Fig. 1.—Interior of Boiler House, using Pulverised Coal.

gasified and completely consumed directly within the chamber desired to be heated. With perfect pulverisation the entire mass is burned in suspension, and in actual practice but a small fraction of 1 per cent. is actually lost in the flue dust or slag pan. In the gas producer there are a series of losses which reduce the available heat considerably, while the mechanical stoker has unavoidable losses due to incomplete combustion. With powdered coal, definite control of the amount of air per unit of coal, due to the method of burning, permits of the most perfect adjustment.

This author does not appear to be very hopeful as to the extensive use of powdered fuel for steam generation, point-

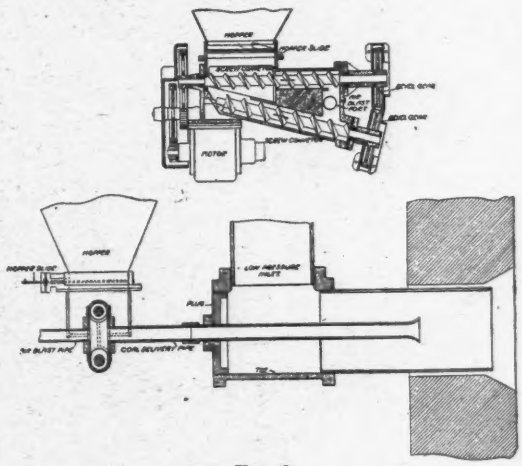


Fig. 2.

ing out that while with powdered fuel the loss in the ashpit and flue does not exceed 1 per cent., with the best mechanical stokers this loss will not exceed 2 per cent. of the coal fired; moreover, a possible advantage of 2 or 3 per cent. in combustion efficiency may be off-set by the cost of coal preparation.

As regards this latter, we may quote the previously mentioned paper by Mr. Gadd, who says:—

From the time the coal leaves the dryer to its delivery in the furnace the whole system between these points should be dustproof and the greatest care should be taken to prevent leakage. This should be guarded against systematically,

as leaks, however small, may permit the surrounding air in the room to become impregnated with coal dust to such an extent that a serious explosion may result.

Coal, after pulverising, should be handled in bulk. All types of aerial propulsion and transfer in the form of dust clouds should be avoided, for the reason that accidental ignition may at any time wreck the whole system.

Screw conveyors and bucket elevators equipped with dust-proof casings are best adapted to handling powdered coal in bulk. Screw conveyors of 9 in. and 12 in. diameter should not exceed 250 and 300 ft. in length, respectively, if the best results are to be expected. Where transmission lines of greater length are necessary they should be divided.

The storage of powdered coal in large or small quantities

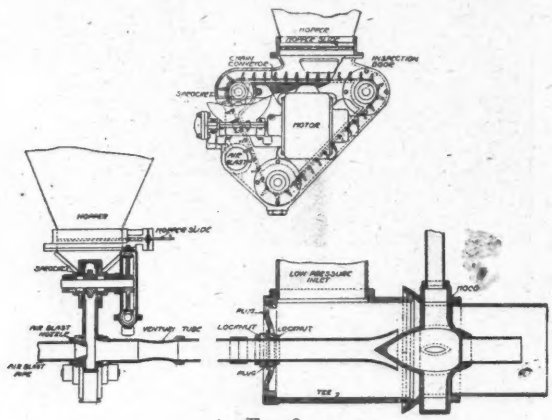


FIG. 3.

for any length of time is not advisable, owing to its tendency to fire, collect moisture, and pack.

Powdered coal in storage, containing about three-quarters of 1 per cent. moisture and 1 per cent sulphur, will invariably fire within six days. If the moisture be increased to over 1 per cent. and the sulphur to 4 or 5 per cent., spontaneous combustion may occur within 24 hours. Probably the temperature at which powdered coal is delivered to the storage bin, and the sulphur content of the coal, influence the rate of spontaneous combustion rather than moisture.

Owing to the hygroscopic nature of dried powdered coal, long storage is not desirable.

In its normal state powdered coal is light and fluffy; after 48 hours' standing in storage, however, the physical arrangement of the particles produces a dense packed mass. So dense does the fuel become that one's fingers cannot make an im-

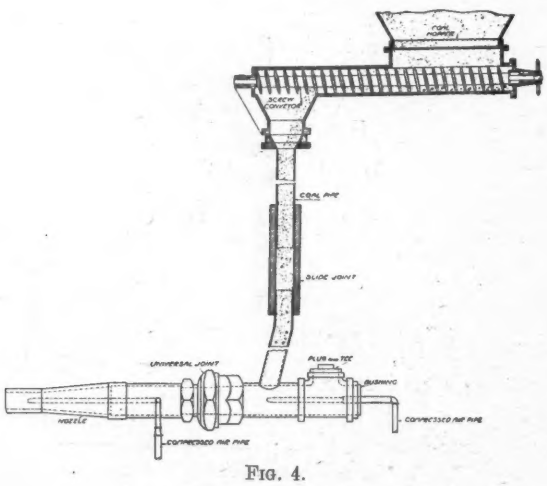


FIG. 4.

pression even one-half inch deep. To meet ideal conditions, powdered coal should be kept in motion.

With properly designed machinery and storage bins, having 12 hours' supply placed at each furnace, the coal may be kept in motion and repairs and adjustments made before the supply becomes exhausted.

The dryer for preparing the coal before pulverising is generally of the revolving cylinder type, with an external furnace and automatic stoker; the power consumed by a complete unit including feeder, fan, stoker, &c., for a 10-ton dryer is about 1–1½ KW.-hours per ton of dried coal. The pulveriser is frequently a type of ball mill; its power consumption for a capacity of about 4½ tons per hour will amount to 10½ KW.-hours per ton of product.

In a plant having an average output of 200 tons of powdered coal per day the cost per gross ton of coal produced (according to Mr. Gadd) is 0.6 dol., the figure being an inclusive one—coal in car to furnace, but with no allowance for overhead and depreciation expenses. Shrinkage in the coal must be allowed for; it amounts to 150–270 lb. per gross ton.

Mr. Gadd goes on to describe the two best known types of powdered coal feeders for furnaces, *i.e.*, the mechanically-operated screw or flight conveyor having variable feed, and the siphon type using low or high-pressure air; some of these are shown in figs. 2, 3, and 4.

On the question of burners, Mr. Harrington says it is generally conceded that the volume of the air should be just sufficient to supply the oxygen necessary for complete combustion; the velocity of the entering jet must be greater than the rate of flame propagation to prevent burning back. The mixture of air and gas, being explosive, must be made close to the furnace; this is also desirable in order to secure uniformity of mixture. The screw feed tends to give pulsating delivery of fuel, and devices have been tried to smooth out the delivery; a constant density of the fuel cloud is important. Mr. Harrington gives tabulated data as to cost of pulverising coal varying from 96.3 cents per ton for 10 tons per day to 30 cents per ton for 250 tons per day, inclusive of interest and sinking fund charges; exclusive of these, the figures are 48.2 and 23.4 cents respectively.

In the discussion on Mr. Harrington's paper, the pulverised fuel installation serving ten 250-H.P. boilers at the Parsons (Kan.) shops of the Missouri, Kansas, and Texas Railway was described; this installation is the largest of the kind, and burns low-grade coals, including lignite, the method being considered the most suitable in view of the ash and moisture content of the raw fuel. The ten boilers will consume about 158,000 lb. of coal in 24 hours, assuming a boiler efficiency of 70 per cent. operating full capacity for ten hours, and half

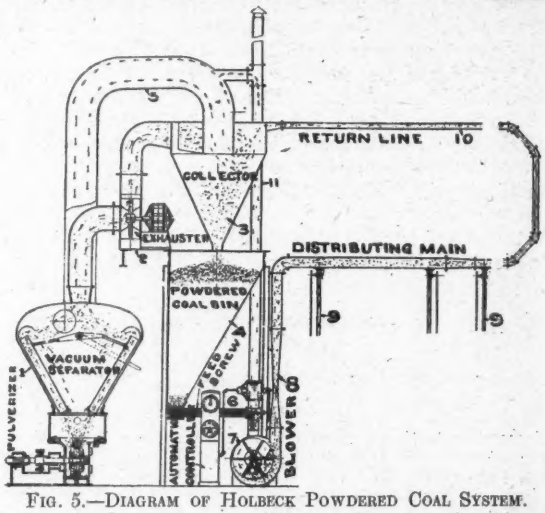


FIG. 5.—DIAGRAM OF HOLBECK POWDERED COAL SYSTEM.

capacity for 14 hours. The coal is dumped into a hopper and passed through a 20 in. × 24 in. crusher, to break down lumps, then conveyed by belt to a pair of 24 in. × 18 in. corrugated rolls, the crushed fuel being elevated and discharged through a screw conveyor into a 40-ton bin, allowing five hours' storage for the drier and mills. From the bin a screw conveyor feeds the coal to an indirect-fired rotary drier, from which it is led to a 45-ton bin, serving two pulverisers. The pulverised coal is elevated and carried by a screw conveyor to the boiler house, the conveyor extending the full length over the bins in front of the boilers, a distance of 216 ft. One bin serves two boilers, a separate feeder being provided to each of the latter; each half bin with its hopper bottom holds 10 tons of pulverised coal, or sufficient for 20 hours running at full capacity. Each bin is filled through three separate gates and spouts from the conveyor.

Under the bin, between the hoppers, is placed a motor-driven fan, supplying air through twin 7-in. pipes, each leading down to a burner nozzle (see fig. 1). The fan supplies the air needed in feeding the coal (4,200 cu. ft. per min.) at 3 oz. static pressure to a burner nozzle in front of each boiler. The hopper bottoms each contain a 4-in. screw feeder, to feed the fuel to the burner, through a 3-in. down pipe. The burner consists of a 14-in. cylindrical pipe, projecting into the furnace; the 7-in. blast pipe projects into this from 12 to 18 in., and is fitted with a cone forming a valve to regulate the air. The powdered fuel is introduced directly over the discharge end of the blast pipe, allowing thorough mixing of the air and fuel; the burner will induce a large quantity of air in addition to that supplied by the fan.

At normal rating on a basis of 70 per cent. efficiency, and with feed water at 208 deg. F., these boilers will each consume 985 lb. of coal per hour, requiring 3,200 cu. ft. of air per min.; half the fan capacity is utilised through the blast pipe, and the remaining air induced through the burner.

The furnace in use consists of a Dutch oven, of 6 cu. ft. capacity, built in front of each pair of boilers, with vertical

baffles. No slag is formed, and the ash is readily blown off the floor of the rear chamber with an air hose once a week. No part of the refractory lining is subjected to an excessive temperature even at overload, and it is stated that the operation is quite flexible, and that highly gratifying results are being obtained.

Our view, fig. 1, of the interior of this boiler house using powdered coal, is from *Metallurgical and Chemical Engineering*, which journal also published the diagrammatic scheme of a powdered-fuel plant shown in fig. 5. This is the Holbeck system, made by the Bonnot Co., of Canton, Ohio.

Bituminous crushed, nut or slack coal is stored in a bin, preferably made of steel or concrete. The coal passes from the bin and an automatic feeder regulates the amount of coal fed to the pulveriser, shown at the extreme left. As the coal becomes pulverised it is thrown up into the vacuum separator 1 by the action of the pulveriser. This separator separates the fine particles of coal dust from the coarse, the finest being drawn into the exhauster 2, and the coarse falling down into the pulveriser.

From the exhauster 2 the powdered coal is blown into the collector 3. The expansion of the air as it enters the collector permits the coal dust that is carried in suspension to fall to the bottom of the collector and into the coal storage tank 4. The air that enters the collector returns through pipe 5 to the pulveriser to be used over again.

The coal dust is taken from the storage tank 4 by the feed screw 6, and delivered into the suction side of a high-pressure blower 7. It is then blown into the distributing main 8, and carried to the furnace through the distributing pipes 9.

The coal which is not used is returned through the return line 10 to the collector 3, where it is extracted from the air and falls into the coal storage tank 4 to be used over again.

The air after the coal is extracted is returned to the suction side of the blower through pipe 11.

BURNING COKE BREEZE.

At the present time considerable attention is being given to the utilisation of coke for steam raising, and in one or two cases encouraging results have been obtained in connection with central-station boiler plants.

The subject is allied to that of gas firing, as the coke or semi-coke resulting from the gasification process will have to be disposed of in some way.

Similar efforts have been made in the States to utilise coke breeze, and the following description of a system of coke firing for boilers, with coke breeze obtained from coke ovens, recently appeared in our contemporary *Power*:—

The average coke breeze produced contains from 25 to 35 per cent. of sand, sulphur, and fire-clay, leading to considerable clinker formation, and to handle this material an overfeed stoking system was developed.

The principle of the stoker system is that the fuel flows through the hopper (fig. 1) by gravity on to a pusher plate,

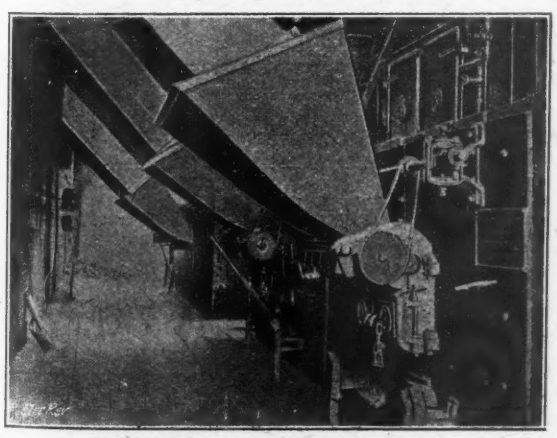


Fig. 1.

whence it is precipitated into an impelling chamber by the pusher, which is operated by a rocking arm in contact with a cam, or from an eccentric attached to the rocking arm. The impellers distribute the fuel over the fuel bed at any required amount up to that necessary to operate the boiler greatly in excess of its normal rating. Fig. 2 shows a front view of the stoker.

To handle the clinkers produced in burning coke-breeze fuel, a specially designed rocking, cutting, and dumping grate is used (fig. 3). The fuel bed is carried about 8 in. thick at the front of the furnace, and as the grates are pitched, a depth of 18 in. is carried at the bridge wall. At intervals the grates are operated for shaking; that is, the points of the grates are dropped about 3 in., and as the clearing space between the bars remains the same, nothing but fine ashes is sifted to the ashpit. The shaking movement is so slight that

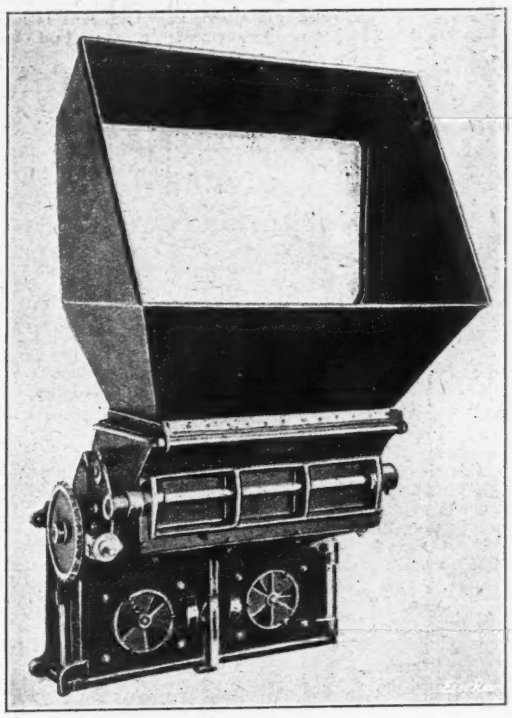


Fig. 2.

the fire bed is not disturbed to any great extent. This movement also prevents the amalgamation of clinker-forming impurities.

The fuel bed as carried by this system is divided into three zones (fig. 4). The first is about 5 in. thick at the front to 15 in. at the back. This residue formation diffuses the air over the grate area and prevents blow-holes in the fire that would be caused by an unequal air pressure. The second fuel zone is carried about 3 in. thick all over the grate surface,

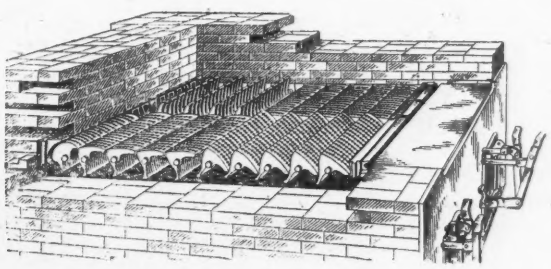


Fig. 3.

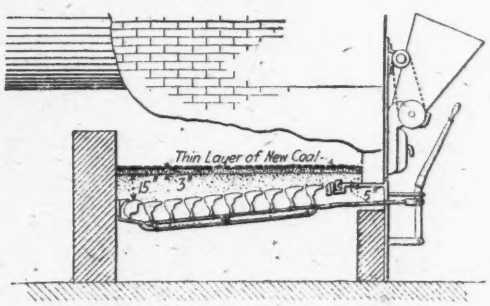


Fig. 4.

and is composed of the incandescent particles of carbon in the fuel. The third zone is the green fuel that is continually sprinkled over the second zone. The moisture in the fuel is evaporated by the heat from below and by reflected heat from the arch above. During the process of combustion the impurities are separated from the combustible and work their way through the layer of residue forming the first zone, where they come in contact with the cold air and are chilled

D

before they become fused in large quantities with one another.

With this kind of fuel it is necessary to operate the cut-off movement of the grates about every two hours, which removes about 1 in. from the bottom of the residue at each stroke. In this way the fires are cleaned without disturbing the fuel bed and without the use of fire tools. The grates used have a 40 per cent. air space, and sufficient steam is used under them to insure the chemical decomposition of the clinker-forming properties.

With by-product oven breeze a turbo-blower is used, because it is not necessary to saturate the air with steam to the same extent as with beehive breeze. Tests showed that 5.96 lb. of water were evaporated per lb. of fuel, from and at 212 deg. F.; the efficiency of the boiler and furnace averaged 53.48 per cent. The intensity of the fire is governed by the stoker speed and steam jet, and an intense heat is obtained.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Woodhouse Patent Automatic Clutch.

While the squirrel-cage motor possesses many advantages over the D.C. motor, and over the A.C. motor with a wound rotor, it has always laboured under one great handicap—the difficulty of starting with a load, and the very heavy starting current taken. However, if the motor can be run up to full speed before the load is thrown on it, this difficulty disappears; the motor is then running under efficient conditions, and can exert a large torque without taking an excessive current. To carry out this plan, a new type of automatic clutch has been devised by Mr. A. E. Woodhouse, and is supplied by the Victoria Dynamo & Motor Co., of Craven House, Kingsway, W.C. This clutch, which is illustrated herewith, is characterised

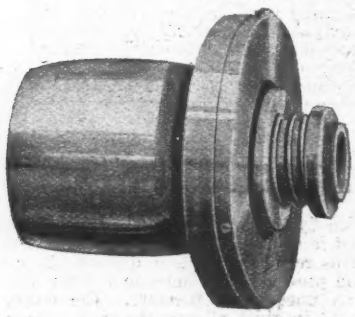


Fig. 1.—Woodhouse Clutch applied to Motor Pulley.

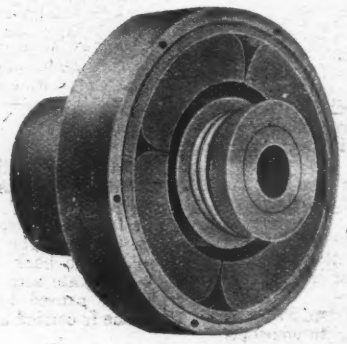


Fig. 2.—Clutch with Cover Removed.

by extreme simplicity and reliability, small number of parts, and smoothness of operation.

Fig. 1 shows the clutch combined with a pulley, fig. 2 shows the parts in position with the cover removed, and fig. 3 is a part section through the clutch, in the position assumed when running at full speed.

The essential features of the device are four cast-iron blocks A turned on the exterior to a cylindrical surface, and on the interior

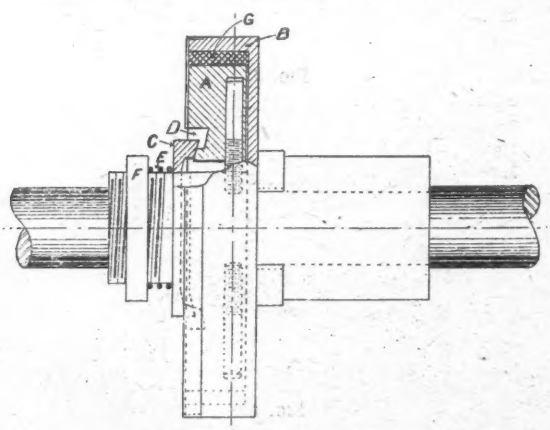


Fig. 3.—Section through Woodhouse Clutch used as a Coupling.

to the shape shown at D in fig. 3; a collar F is pressed against the blocks by a spring E, controlled by an adjusting nut C on a screwed sleeve which is secured to the shaft, the pulley, of course, running loose on the sleeve. The pulley carries an overhung cylindrical casing B lined with "Ferrodo," as indicated at G.

When the motor is at rest, the four blocks are drawn radially inwards by the pressure of the collar on their coned surfaces, and the rotor is free to run up to speed without load; when a predetermined speed is attained the centrifugal force of the blocks overcomes the action of the spring and the collar slips off the cone, allowing the blocks, which slide on radial studs, to fly out and apply themselves to the casing, with sufficient friction to bring the latter and the driven load up to speed in a few revolutions, yet without any shock. The frictional grip of the clutch enables it to carry a load 50 per cent. in excess of full load, and there is no perceptible slip between the parts, hence no heating and very little wear, except when taking up the load. The accuracy of adjustment is such that the clutch can be regulated to operate at a few revolutions below full speed, and, once set, the nut can be fixed in position with a grub screw. When the current is shut off the motor, the clutch does not release until the motor is on the point of stopping; the steeper cone, shown on the blocks in fig. 3, then comes into play, the collar draws the blocks inwards and slips on to the inner cone, restoring the clutch to its normal position before the rotor comes to rest. All parts of the clutch are perfectly balanced, so that no vibration is set up. It can be used either as a pulley or coupling, or both; and as slip-rings, commutators, and an expensive starting switch are dispensed with, the cost of the motor with this clutch is less than that of the apparatus otherwise required; moreover, a heavy load can be started up with a smaller motor. We understand that some of these clutches have been running for three years with satisfactory results.

Looping-in Distributing Mains.

The localisation of faults in distributing cables is a troublesome matter, even when disconnecting boxes are provided in the network, and usually involves a good deal of inconvenience to consumers whose supply has to be cut off while the fault is found and repaired. To obviate this trouble and to provide a ready means of running a fault "to earth" quickly and with the minimum of annoyance to consumers, Mr. F. E. Frampton, engineer to the Paignton Electric Light & Power Co., in conjunction with Messrs. Callender's Cable and Construction Co., Ltd., of Hamilton House, Victoria Embankment, W.C., has patented an ingenious method of looping the mains into consumers' premises, where they can be disconnected and tested with ease, and with little interference with the supply. As shown in the accompanying figure, which applies to a three-wire system, one of the outers is cut at each distributing point or service box and the ends are connected to a pair of terminals in any suitable house, lamp pillar or similar fuse box; these terminals are connected together by a removable link which forms one terminal of the circuit supplied, the other terminal being connected to a service lead in the ordinary way. By disconnecting the link from one of the loop terminals, the distributing cable can be cut, whilst the supply—if connected to the sound side of the cable—to the consuming circuit is maintained, and by repeating the process at the next service taken off the same cable, the intervening portion of cable can be isolated and repaired at leisure, whilst the supply is maintained to all the consumers (if the cable is fed from both ends). If desired, the links can be constructed to act as fuses, so that a fault on the distributing cable will be automatically isolated. By graduating the section of the fuses the length of cable thus isolated can be restricted to the minimum. Obviously, with the

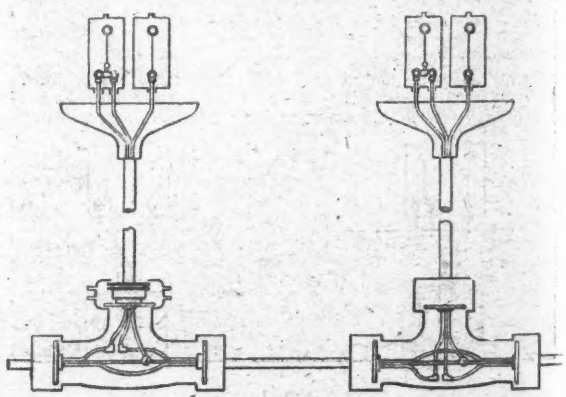


Fig. 4.—Frampton-Callender System of Looping-in Services.

aid of the links, any part of a distributing system can be isolated and tested at any time. The invention is applicable to systems other than the three-wire system, and should prove useful to supply station engineers.

Catalogues Wanted in Italy.—Messrs. Alexander Hamilton & Sons, of Messina, who have been established in Italy since 1880, are asking for catalogues and price lists of British engineering and electrical manufactures.

WILLANS SURFACE-CONDENSER TESTS.

The following test results were obtained on one of five surface-condensing plants, embodying the Willans & Robinson rotary air-pump system, and recently installed at the London and South-Western Railway Co.'s Durnsford Road power station.

The station contains five identical plants, each of the same capacity, in addition to two similar plants of smaller size.

The main feature of this system is that the circulating water is passed through an ejector, which is shown on the accompanying drawing at B, and takes the place of the ordinary air pump. A separate pump C is provided to withdraw the condensed steam from the surface-condenser, and to return this to the hot well. An automatic non-return valve A is placed between the air ejector and the main condenser body, so as to prevent water being drawn into the condenser in case of failure of the ejector.

There are three common forms of application of the system known as the "series," the "shunt," and the "separate pump" types respectively.

In the case of the "series" type of plant, the whole body of the circulating water is passed through the air ejector before entering the condenser; that is to say, the circulating pump is designed for the normal quantity of water required by the condenser, but allowance is made in calculating the head for the necessary drop across the air ejector.

In the case of the second, or "shunt" system, the cooling water for the condenser and the ejector water are delivered in parallel, and the ejector water is returned to the source of supply or to the circulating water suction. In other words, the circulating pump is designed for the normal head required by the lay-out of the plant, with allowance for condenser friction, and the quantity delivered is that needed for the condenser itself, plus the necessary water for the air ejector.

The third, or "separate pump" type, of which the L. & S.W. installation is an example, differs from the "shunt" system only in that a separate pump is provided for delivering the air-ejector water, apart from the main circulating-water pump which supplies the condenser in the ordinary way.

In the present installation, both the main circulating pump and the ejector pump draw their water by means of a common suction pipe from the main suction culvert, which runs the full length of the engine room. The water coming from the condenser itself is, of course, heated and passed to the delivery culvert, but the air-ejector water is returned to the suction or inlet culvert.

It will be noted that in this instance the circulating pump is driven by means of a continuous-current motor, whereas the ejector pump D and condensate extraction pump C are driven by a small steam turbine.

The tests show that the vacuum attained is substantially above that guaranteed, and particular attention may be drawn to the very low difference between the circulation-water outlet and vacuum temperatures.

Trial number.	1.	2.	Guarantees.
Duration of test	60 minutes	60 minutes	—
Load, lb. of steam per hour	68,176	68,389	68,000
Vacuum at steam inlet to condenser, corrected to 30" barometer	28·73"	28·76"	28·5"
Corresponding steam temperature	86·6° F.	86° F.	92° F.
Condensate temperature ...	82° F.	82·5° F.	87° F.
Difference between condensate and vacuum temperatures	4·6° F.	3·5° F.	5° F.
Circulating water inlet temperature	58·5° F.	58·5° F.	65° F.
Circulating water outlet temperature	80·8° F.	81·1° F.	83° F.
Difference between circulating water outlet and vacuum temperature ...	5·8° F.	4·9° F.	9° F.
Cooling water, gallons per hour	318,000	317,600	396,600

The test was carried out after the plant had been in service for a considerable period, in the presence of the representatives of the consulting engineers, Messrs. Kennedy & Donkin, and of Mr. Herbert Jones, chief electrical engineer to the London and South-Western Railway Co.

Germany's Iron and Steel Production.—The Amsterdam correspondent of the *Morning Post* says that at a meeting of the German Stahlwerksverband, held recently at Düsseldorf, it was stated definitely that the export of iron and steel to neutral countries had been stopped until further notice, home requirements and the demands of the German army and the Prussian railways being so great that only very small quantities were available for external trade.

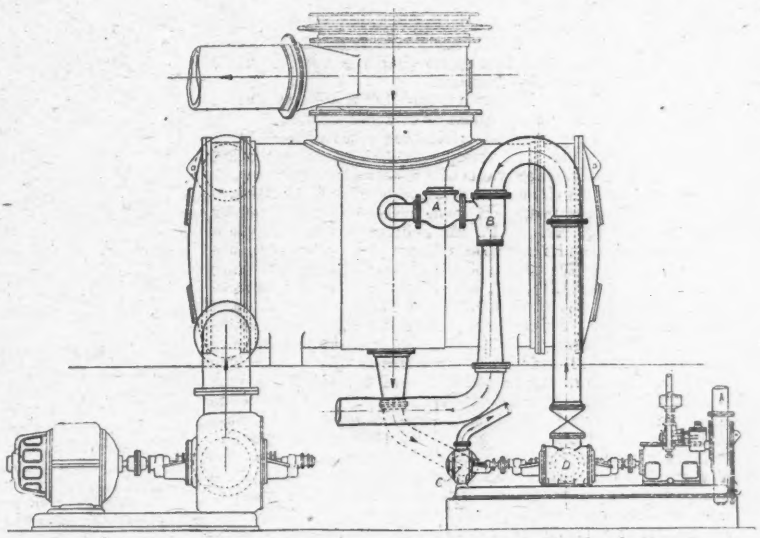
LEGAL.

Assessment Appeal by the Metropolitan Railway Co.

At the County of London Quarter Sessions, at Clerkenwell, Sir Robert Wallace (the Chairman), began the hearing of an appeal by the above company against certain quinquennial assessments of their properties in Kensington, Paddington, and the Holborn Union.

Mr. Walter Ryde, K.C., and Mr. E. M. Konstam represented the appellant company, Mr. Page, K.C., and Mr. Cecil Whiteley were counsel for the Royal Borough of Kensington, while Mr. Clavell Salter, K.C., M.P., with Mr. Bethune and Mr. W. J. Jeeves, represented the Borough of Paddington and the Holborn Union.

In opening, Mr. Walter Ryde said that in Kensington a rateable value of £9,000 was appealed against, and the Railway Co. claimed that the amount should be £3,750. In Paddington it was contended that the figures, instead of being £7,314, should be £3,732 and in the Holborn Union £16,000, instead of £21,800. Dealing first with the Kensington case, counsel said the railway was worked generally by means of electric traction, and for the purpose of supplying electricity the company had erected from time to time, and now used, a generating station at Neasden, 10 electrical sub-stations, and other large and extensive works. All these works were not directly productive of profit, and all of them, with the exception of a sub-station at Gloucester Road, were out-



Arrangement of Willans Condensing Plant; L. & S.W.R. Power Station.

side the borough. Appellants contended that the assessment, so far as it consisted of directly-productive portions of the undertaking, was excessive in proportion to the value of the whole undertaking. It was submitted, further, that the value of the property had diminished, and was diminishing, owing to the increasingly severe competition of other railway companies, tramway and motor-omnibus undertakings, and other methods of transit. Moreover, working expenses had largely increased during recent years, and that increase was likely to continue. They submitted that the rateable value of running line in Kensington—of a total length of 1 mile 75 chains—should not be more than £594, and that the rateable value of other hereditaments, consisting of station, booking offices, and refreshment rooms at Notting Hill Gate, and portions of the Stations at Kensington High Street, Gloucester Road, and South Kensington, should not be more than £3,156. That would make a total assessment of £3,750, against the £9,000 at which it had been assessed. As to the property in Paddington, where the appellants submitted that the rateable value should be £3,732 instead of £7,314, much the same arguments applied as in the Kensington case.

The Chairman: There is no question of stations in Paddington?

Mr. Ryde: No; but I observe, on glancing at the respondents' case, that they say the assessment in force in 1915 was £1,440 for lines, and £3,700 for stations and sub-stations. Counsel went on to say that the case in the Holborn Union concerned an area in Clerkenwell, and included part of Farringdon Road Station. Appellants contended that an assessment of £21,800 should be reduced by £5,800. He believed the Metropolitan Railway Co. had the unfortunate distinction of having the smallest receipts per train-mile of any considerable line in the country, and that, of course, was brought about by two important causes. In the first place, there was the enormous percentage of third-class traffic; and, secondly, the enormously high percentage of workmen's tickets. The year 1913 was the last complete year for which gross receipts earned and train-miles run could be ascertained by actual calculation, owing to the Government having assumed control of the railways, but counsel submitted that on evidence he should call, it would be seen that in 1915 there had been a drop of 9·76 per cent. in the traffic over the three districts in question. It was said on the other side that they must adhere blindly to the accounts

for 1913, but appellants contended that they must look to what had happened since.

The first witness was Mr. R. H. Selbie, the general manager of the Metropolitan Railway.

On behalf of the appellants, it was contended that the railway lines which were used wholly for electric traction should be treated as a minus quantity, or capable of only nominal assessment. Surveyors who gave evidence on appellants' behalf stated that they had made their calculations on the basis of the published accounts for the year 1913, but amended to include the extra cost of wages and materials as between the years 1913 and 1915. In Kensington, it was submitted, the net rateable value should be £3,750 instead of £9,000 fixed by the Assessment Committee; in Paddington, £3,732 instead of £7,314; and in the Holborn Union a reduction of over £8,000 was suggested in an assessment of £21,800.

Among the witnesses for the appellants were Mr. W. A. Agnew, chief mechanical engineer of the District Railway; Mr. Theodore Stevens, consulting engineer, of London House, E.C.; Mr. G. W. Partridge, chief engineer of the London Electric Supply Corporation; Mr. William Willox, permanent way engineer of the Metropolitan Railway; Mr. C. L. Morgan, chief engineer of the London, Brighton and South Coast Railway; and Mr. Crister Peter Sandberg, consulting and inspecting engineer, of Westminster.

Mr. G. W. Partridge said he had examined the motors of the Metropolitan Railway at their works, in conjunction with Mr. Theodore Stevens. The stock was worth 85 per cent. of the total replacement cost, or more than that. He agreed with Mr. Stevens that if they spent 15 per cent. on it they would have a stock up to the 100 per cent. standard.

The case on behalf of the Kensington Assessment Committee was opened first, and Mr. Page, K.C., submitted that it was ridiculous for the other side to suggest that the running lines should bear no part of the local burdens.

Sir Robert Wallace: I observe it said that the rateable value of line in Kensington is a minus quantity of about £3,000.

Witnesses called in support of the Kensington assessment based their calculations on the local receipts of £52,506 for 1913, and arrived at a margin of rateable value of £5,000 and £6,000.

Sir John Snell, who had been retained by the various Assessment Committees concerned, next gave evidence. Examined by Mr. Clavell Salter, K.C., M.P., Sir John said he had made a careful examination and inspection of the generating and substations and rolling stock of the Metropolitan Railway, excluding the Great Northern and City, and submitted a mass of figures dealing with estimated cost of repairs, maintenance, renewals, and various other matters. He estimated the total renewals and maintenance of rolling stock at £63,511; the annual repairs and maintenance at £23,513, and the average life at 16½ years. The result of his calculations was to allow the railway £86,000 a year in respect of electric current, instead of the £64,000 which the company actually spent in 1913. The electric installation generally was comparatively new, and on that ground he had allowed for repair and renewal a much larger sum than was actually expended in 1913. The company were entitled to claim what would prove to be the average on the year. The working expenses he had increased from £73,000 to £95,000. The company's abstract gave locomotive running expenses as 16½ per cent. of the traffic receipts; he had changed that to nearly 19½ per cent. The agreed replacement-cost of electric rolling stock was £875,842. He put the annual depreciation at £39,998; the average age, 7·47; amount of depreciation, £300,773; value at December 31st, 1913, £575,076.

In cross-examination by Mr. Ryde, K.C., Sir John Snell said he believed £80,000 worth of stock was added in 1914.

Mr. Ryde: If I give you the life of a machine you have never seen, you could ascertain, as you have done here, the depreciation per annum?

Sir John Snell: Certainly.

Mr. Ryde: Although you had never seen it? I could not.

Sir John Snell: Why not? Because you are not an engineer.

In further cross-examination, Sir John said they could not take the renewals of rolling stock by themselves or maintenance by itself, and if he could prove the amount he had allowed to cover both those items, then he met all the points upon which counsel was trying to cross-examine him. He, personally, made a valuation of Neasden power house, and was actually in the power house for an hour. He made an inventory some years ago, and only had to see the additions. In his calculations he had taken steel rods at £7 a ton, which was the 1913 rate.

Mr. Ryde: Is that likely to be the ruling rate after the war is over?

Sir John: That is an awkward question. I cannot say.

At the conclusion of Sir John's cross-examination, Sir Robert Wallace said he did not want to hear any further evidence. He was perfectly satisfied that the rateable value appealed against was lower than its true value. His Lordship added that in all the years he had sat in the Court he had never heard an appeal which was more unjustifiable than this one. The appeal would be dismissed, with costs.

The hour for the rising of the Court had been reached, and Mr. Clavell Salter inquired if Mr. Ryde proposed to go on with the appeals in respect of the property in Paddington and the Holborn Union.

Sir Robert Wallace said he did not think Mr. Ryde ought to be asked that question. He thought the better way would be to give counsel an opportunity to confer together in regard to the remaining cases.

His Lordship subsequently fixed the next Court for November 14th.

Toronto Electric Light Co., Ltd., *v.* Corporation of the City of Toronto.

In the Privy Council, on October 23rd, judgment was given in this case, which was argued just before the Long Vacation.

The Board consisted of Viscount Haldane and Lords Atkinson, Shaw and Parmoor.

The action was brought by the appellant company for an injunction to restrain the Corporation from interfering with the appellants' plant by cutting down, removing, or otherwise interfering with their poles and wires upon the streets and other public places in the city.

Sir John Simon, K.C., Mr. Hellmuth, K.C., and Mr. Auglin, instructed by Messrs. Blake and Redden, appeared in support of the appeal; Sir Robert Finlay, K.C., and Mr. G. R. Geary, K.C., instructed by Freshfields, for the respondent Corporation.

Lord Atkinson, in delivering the considered opinion of the Board, said that the appeal was from a judgment of the First Appellate Division of the Supreme Court of Ontario, whereby a judgment of the trial judge in favour of the plaintiff company was set aside, and it was ordered that, subject to certain declarations, the action should be dismissed with costs. The case was not free from difficulty, for some important transactions which took place between the parties were not in writing. The company was incorporated by Letters Patent in 1883, by an Act which purported to confer the power, *inter alia*, of manufacturing electric light and power, and the erection of plant and all machinery necessary for lighting the streets and houses of the city. In exercise of this power the company established an extensive system for the distribution of electricity over almost the entire City of Toronto. It supplied current to private customers and to the respondent Corporation for the lighting of the street lamps. The system in 1912 was a composite one—partly overhead, partly underground—but intercommunicating. Much the larger part was overhead. It then covered 370 street-miles, the wires being carried on 15,705 poles erected on the streets and public places of the city. These poles carried 1,450 miles of wire. The underground system then consisted of about 350 miles of single conduit laid in 28 to 30 street-miles. The two systems were so "interlaced" that if the overhead construction were removed, the underground in some instances would have no connection with the terminal stations or sub-stations of the company, or with any source of power. It was not disputed that the cost of constructing underground conduits so far exceeded that of carrying wires overhead on poles that, having regard for the prices obtained for the current, the former system was only commercially possible of adoption in a limited and favoured area in the city where customers were both large and numerous.

In this state of things the Corporation on February 6th, 1912, passed a resolution denying, among other things, (1) the right of the company to lay any underground conduits outside the limits of the city as they existed in November, 1889, when an agreement was entered into between the company and the Corporation; and (2) its right to construct pole lines within the city, save for the purpose of implementing its contract with the Corporation for street lighting. They followed this up about the middle of October, 1912, by preventing by force the company from erecting additional poles and wires, and also removed certain poles, part of the company's overhead system which had been in actual use some three years.

The action was then instituted by the company, claiming an injunction, damages, and further relief.

As stated above, the injunction granted at the trial was set aside on appeal.

His Lordship then referred to the various agreements which had been entered into between the parties. In reviewing these, their Lordships thought that the provision touching the purchase of overhead plant contained in the agreement of November, 1889, meant no more than this: that the Corporation should be entitled to purchase, when they purchased the underground systems, such poles and plant of the overhead system as might be then found lawfully erected on the streets and public places of the city. No estoppal arose in this case, as there was no evidence whatever that both the contracting parties were not fully aware of their respective legal rights. It might well be that the company never anticipated that the respondents would insist upon the removal of the poles carrying wires erected with their implied consent, but not in pursuance of any formal agreement. With the hardships (if any) or the moralities of the case, the Board had no concern. It dealt alone with the legal rights of the parties, and having regard solely to them, their Lordships were, on the whole case, of opinion that the judgment appealed from was right, and should be affirmed, and this appeal of the company dismissed with costs.

British Thomson-Houston Co., Ltd., *v.* Duram, Ltd.

Mr. Justice Astbury in the Chancery Division, on the application of counsel, fixed December 4th next for the hearing of this action.

Counsel said the case was a heavy one, and the defendants as much as the plaintiffs wanted time to get it ready.

Bayonet Key Switch Holders.—The Electrical Supplies Co., of Tottenham Court Road, inform us that they have brought out a patent key switch holder, with shade carrier and cord grip, and are carrying extensive stocks at their London stores.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Electrical Market in India.

At present there are several big cities in India being electrified, and this has created a very big demand for electrical goods in that country. I believe that if the British manufacturers let this opportunity slip, the whole Indian market will go to the Americans for ever.

After a long stay in America and in this country, I am going back to my country, India, where I am intending to take up electrical business. I shall be pleased to be brought into touch with British manufacturers of small ice-making machines, small wheat-meal grinding machines, small printing machines and pumps, to be driven by continuous current, and other electrical specialities.

J. Khanna, B.Sc., E.E.

12, Highbury Hill, London, N.,
October 25th, 1916.

The Cost of Daylight v. Electric Light.

There is so much misapprehension about daylight costing nothing, that I wish you would give me sufficient space in your columns to publish the following letter by Mr. M. Luckiesh, of the National Electric Lamp Association Laboratories, Cleveland, in a recent number of the *Lighting Journal*:—

"In lighting discussions, it is not uncommon to hear such statements as this: 'A great virtue of daylight is that it costs nothing.' Outdoors this is usually true, but in the vast field of human activities, where artificial light aids and competes with natural light, such a statement is absurd. From the standpoint of construction, openings such as windows and skylights are not costless. In other words, interest upon a permanent investment as well as a maintenance cost must be charged to the day lighting, and therefore at once it ceases to be free from cost. Furthermore, when the value of land, especially in large cities, is considered, a light court in the middle of a multi-storied building adds to the cost of daylight. In such a case a large area of rental space is sacrificed for the purpose of admitting daylight, and it appears that the cost of daylight would not be inconsiderable. Of course, light courts provide ventilation, but it seems possible that ventilation could be provided without such a great sacrifice of space."

F. Willcox.

London, E.C., *October 26th*, 1916.

WAR ITEMS.

Exports to China.—The "London Gazette" for October 27th contains a further list of persons and bodies to whom exports to China and Siam may be consigned.

Lord Balfour's Committee.—The Prime Minister has appointed Mr. Richard Hazleton, M.P., Sir William McCormick, Mr. A. McDowell, and Mr. John O'Neill to be members of Lord Balfour of Burleigh's Committee on Commercial and Industrial Policy.

Air-raid Warnings.—The Highways Committee of the L.C.C. reports that, at the request of the Commissioner of Police of the Metropolis, it has arranged a scheme for warning drivers and conductors of tramcars of possible hostile air raids. The expenditure involved is estimated at £624.

The *Times* says that tramcar drivers will receive a signal from the power stations, when they will at once slow down and shut off on approaching certain points where flashing would ordinarily be produced by crossing.

Enemy Interests in British Companies.—In reply to a question asked in the House of Commons by Sir John Lonsdale, Mr. Pretyman said that the returns made by British companies to the Public Trustee showed a total nominal amount of £31,691,724 of ordinary, preference, and debenture capital held by enemies. This total, which included a considerable amount of capital in companies registered in the Dominions, was estimated to represent not more than ½ per cent. of the capital of British companies as a whole. These enemy securities were not as a general rule being sold, except where the particular company was within the provisions of Section 1 of the Trading with the Enemy Amendment Act, 1916, when the company was dealt with either by winding up or by the alternative method of vesting the shares in the custodian for the purpose of sale.

Dilution and Man Power.—The "Times" publishes the following statement issued from the office of the Labour Adviser to His Majesty's Government after the conference held on October 27th:—

"A conference of representatives of skilled trades connected with the engineering and shipbuilding industries was held. The Right Hon. Arthur Henderson, M.P., who presided, said the conference was one of several to be held in connection with the office of the Labour Adviser, at the request of the Man-Power Distribution Board, to consider their proposal that dilution should be extended to private and commercial work in controlled and non-controlled establishments. Hitherto such dilution as had been secured had been limited, speaking generally, to war work. It was now essential that substitution and dilution should become much more general. This was called for by the urgent need of securing for general military service all the men available and eligible up to the limits of the Military Service Acts, by the great demands for skilled workmen for the technical units of the Army, and for the production of munitions and ships, and by the vital importance of continuing our export trade in order to maintain the financial strength of the British Empire and our Allies.

"The present unsatisfied demands of the technical units of the Army and of munitions, skilled and unskilled, are 160,000, and the skilled requirements alone were 32,000. It was the desire of the Government, as recently stated by the Prime Minister to the engineering trades deputation, that the skill of the workmen should be utilised to the best interests of the nation. This could not be secured without further dilution, and this conference had been called to consider the best means of securing this.

"After a full discussion the conference decided to adjourn in order to obtain from the Man-Power Distribution Board information as to the best means of preventing the enlistment of skilled men, which still continues, and of securing better methods of debadging, and to await a report as to the local machinery contemplated by the Man-Power Board for giving effect to dilution on private and commercial work."

Exemption Applications.—At Bermondsey, Mr. W. E. J. Heenan, engineer-in-charge of the Bermondsey Borough Council electrical works, applied for the exemption of a boiler cleaner and repairer. He stated that the man was in the employment of the Council before the outbreak of war, and joined the Expeditionary Forces at the commencement of the war, serving about 14 months in France, and was discharged as a time-expired man in February. They could not get men to do this kind of work. They had 11 boilers, and 700 joints had to be made on each boiler. He had applied for a badge for the man, but it had been refused. This was the only man he had appealed for. Ald. Wills: You had a complaint from consumers that the voltage was low, and that was due to labour difficulties? Mr. Heenan: It was due to boiler difficulties. At present we have two boilers down. Coun. Shearring said that the man was doing work of national importance. Six months' temporary exemption was granted.

At the Aberdeen Military Tribunal, Messrs. Bell & Lyon asked to retain the services of David L. Mitchell, electrical engineer. Conditional exemption was given while badged.

At the Rhyl Tribunal, Mr. E. H. Wright, the electrical engineer, secured three months' exemption for D. Kingston, 39, married, engine-driver and switchboard attendant at the electricity works, and T. J. Parry, 41, married, cable jointer. Both were considered absolutely indispensable to the electricity department, and Mr. Wright added that in other districts there was no difficulty in retaining such men altogether.

At the Brighton Tribunal, the West Pier Co. applied for their electrician and their blacksmith, who had been given time previously. It was explained that a man engaged in pier repair work has to be somewhat of a sailor as well as an electrician, because the action of the water was apt to make him dizzy. Repairs had to be done to the pier, amounting roughly to a large sum of money, before the spring, and these men could not be replaced. They could not get men to work under the pier. The electrician was given two months, final, and the blacksmith three months.

At the Dundee Tribunal, Prof. Peddie, of the Chair of Physics, University College, made a statement with regard to J. Robinson (22), instrument maker. He said that Robinson's work was fundamentally necessary in the work of the college. He was engaged in the making of optical, electrical, mechanical, and other scientific instruments, to which he had served seven years apprenticeship before he came to the college, and since then he had had three years' experience of construction work, and had acquired special scientific training. All the departments would suffer if Robinson was taken away. He was the only skilled mechanician in the college. Lord Provost Don said that in view of what the Tribunal was doing with some other cases they must sustain the military appeal that Robinson should go to the Army.

The manager of the Darlington tramways, when appealing for the exemption of a mechanic, single, aged 33, who had been passed for general service, said the man was the only skilled person on the system. If he had to go into the Army it would mean that gradually the trams would come off, and there would be no service. Exemption to the end of the year on the ground of public utility.

At Maidenhead, the electrical engineer (Mr. Milton) appealed for E. G. Pink (35), shift engineer; G. A. Cox (32), shift engineer; W. T. Shervell (25), engine-driver and fitter; A. R. Mills (20), driver and stoker; W. J. Mundy (23), cable fitter; and W. L. Chubb (32), foreman. The Tribunal's investigator reported that there were only 14 skilled men engaged at the works, which revealed the fact that the works were much understaffed. He deprecated young men being employed in highly technical work, and he hoped that those who had been passed for general service would be released as soon as possible. He recommended conditional exemption until February 1st, the manager to do his best to release those classified "A" from time to time as he was able. Mr. Milton said it was possible they might be able to carry on with less men after Christmas. The recommendation of the investigator was agreed to.

At Dartford, on October 23rd, the Tramway authority appealed for four drivers, and it was pointed out that although substitutes could not be found, the Military authorities wished the service to be kept in a state of fullest efficiency. Two were exempted as being in a certified occupation, being over 30 years of age, one was conditionally exempted with the right of a further appeal, and the fourth was refused exemption.

Whitehaven Tribunal has refused exemption to an electrical fitter (25), applied for by a local firm of electrical contractors, and who could not be replaced.

At Weston-super-Mare, conditional exemption was claimed by Mr. W. J. Badman (37), of Messrs. W. J. Badman & Co., electricians, Bristol and Weston-super-Mare. He said that he attended to work at the Weston Hospital, and had no partner. He had been thrice rejected, and was now passed for garrison duty abroad. If he had to go, the Bristol business would have to be closed, and all the outside work at Weston dropped. Exemption until March 1st was allowed.

At Bath, the Electric Tramways Co., Ltd., appealed for H. J. Whitmore (36), wireman. The Military representative did not contest that the man was certified and indispensable, and three months were granted. In the case of two fitters passed for C 3, the appeals were withdrawn without prejudice until they are called up, one of the two being directed to join the Volunteers.

At Stoke-on-Trent, on October 25th, Mr. W. Thorn, general manager of the Potteries Electric Traction Co., appeared, and the Chairman stated that, after careful consideration, they had come to the conclusion that out of 68 eligible men under the age of 30 years the Tribunal must have 38. They did not propose to ask the company to release all the men at once, but would be satisfied with 20 immediately, and the rest in six weeks' time. Mr. Thorn said that if the Tribunal insisted on that number the company would have to close part of the business. The men were all experienced, and were distributed over the different departments. A large proportion of the men were skilled engineers, and if released would not go into the infantry, but would be sent into munition works or be placed in units of the Army where their special qualifications would be utilised. The Tribunal decided to take the 20 men immediately, and gave the company two months for each of the remaining 18.

Two further appeals were made at Aldershot, on October 24th, by the Aldershot & District Traction Co. for two drivers, aged respectively 31 and 30. It was stated that the difficulties of the company were now more acute. The younger man was given a final month, and the other case was put back until November 14th, when the Tribunal will consider how many men are necessary to keep open the trunk lines.

Mr. F. H. Rippon (39), electrical engineer, of Newquay, appealed to the Cornwall Tribunal against the local decision limiting exemption to January 1st. Colonel Buchanan said that had he been present when the appeal was heard locally, and Mr. Rippon had been given exemption, he should not have said a word. He was as much entitled to exemption as any man in Newquay. The Chairman said that as all his men had gone, Mr. Rippon deserved every consideration. The appeal would be allowed, the case would be reconsidered in January, and he might or might not be sent on then.

Messrs. E. J. Philpot, electrical engineers, appealed at Canterbury, on October 23rd, for exemption for A. S. Fassum (31), wireman, and S. Kingham (29), fitter. Mr. H. Philpot stated that the firm were responsible for the maintenance of the electric light and power installations at the Kent and Canterbury Hospital, and other hospitals, schools, hotels, &c., and they were negotiating for a contract with the Military authorities. Skilled men were essential, and Kingham was the only skilled mechanic left. The Military had offered a substitute, but the man was useless. Three months were granted to each.

An appeal was made at Canterbury for E. E. Walters (32), in charge of an electrical plant for Messrs. Saunders & Co. Two months were allowed, with the intimation that probably this term would be final.

At a sitting of the East Kent Appeal Court, on October 24th, exemption was claimed for A. E. Couley (37), in charge of the electrical plant at Sellindge for Major Galway, who is at the Front. It was stated that the efforts to get someone to attend to the plant had failed. Three months were allowed.

An appeal by the Military representative to the East Kent Appeal Court against exemption allowed to W. H. Harriott (38), electrician to the Margate Cinematograph Co., has been withdrawn, respondent having joined up.

Brentwood Tribunal, on October 23rd, gave four months' exemption to G. Hearn, attendant of the electrical plant at Coombe Lodge Hospital.

An Ashstead (Surrey) appellant, engaged on electric storage batteries, stated to be doing work of national importance, has been given conditional exemption.

Kidderminster Tribunal has granted three months' exemption to Mr. J. A. Mitchell, electrical engineer.

At Folkestone, the Electricity Supply Co., Ltd., appealed for the retention of an articled pupil, E. Lepper, on the grounds of national expediency and education. The managing engineer, Mr. T. Hesketh, said that there were five single men of military age employed at the works. The Chairman said that the Tribunal felt that lads of this sort were an asset to the country, and that Lepper's education should go on. There would be conditional exemption.

At Sheffield, the Wolf Safety Lamp Co. appealed for two electricians, W. Robson (28) and R. S. Harvey (25). The former, who is unmarried, was allowed no time, and the latter was given until November 30th.

The City Tribunal heard an appeal by the Corporation for an electrical engineer and engineer-in-charge under the Public Health Department, and the claims were disallowed. Two months' postponement was given to a foreman electrician.

According to the *Surrey Herald*, at the Weybridge Tribunal last week Mr. S. H. P. Wolferstan, the resident engineer and manager of the Urban Electric Supply Co., Ltd., Weybridge and Walton, referred to various statements made at the previous sitting. He observed that the statement concerning employés of electric generating stations being automatically badged was entirely inaccurate. As far as the Weybridge electricity works were concerned, and the substations in the Walton area, he could say, without fear of contradiction, that not one man was, or ever had been, automatically badged; any badges which had been issued by the Ministry of Munitions had only been so issued after inquiry into the special duties of each individual man. He believed this was the case with all electricity works, and the fact that the Weybridge electricity works had been certified as a munition works by the Ministry of Munitions did not alter the case in any single respect. The idea had gained wide currency that electricity works in general were swarming with badged men eligible for service. In the case of the Weybridge works there was likewise in this respect also not the slightest truth in the supposition. The total number of men in the Weybridge and Walton works who were eligible for service, and who were badged, was only six, out of a staff of about 30. Two of these badged men were only just 18 years old, and were, therefore, not yet eligible for military service. This left a total of four badged men eligible for military service in the Weybridge and Walton works, of whom three were married. Mr. Wolferstan went on to refer to the work that was being rendered to the national cause by the undertaking. In order to maintain an efficient supply, to attend to repairs and breakdowns by day and by night, and in order to carry on the private contracts, there was a staff of electricians consisting of one foreman and three wiremen. Their area of supply was very wide, extending for many square miles.

With reference to the company's appeal for a wireman named Gale, Mr. Wolferstan said if the Ministry of Munitions had considered it necessary to certify the Weybridge electricity works, it was submitted that the carrying on of an efficient and uninterrupted supply was of primary importance.

The Military Representative (Lieut.-Col. Phayre) said he had received a letter from the Weybridge Advisory Committee reporting with reference to certain allegations made in a communication, received by the Clerk, concerning a man named Newman, in the employ of the company. They reported that every facility was afforded by Mr. Wolferstan to the Committee, who satisfied themselves by inspection of the company's books and other documentary evidence that the statements on which the company received a badge and certificate for Newman were absolutely correct. There was no doubt that Newman was a highly skilled man doing skilled work. The Tribunal granted conditional exemption to the wireman, Gale.

Last week the City of London Local Tribunal heard an appeal on behalf of an electrical fitter. His employer stated that the man had charge of the telephones and other electrical apparatus, as well as of the burglary alarms, of various firms in the City, and his expert knowledge was essential to the work. He was the only electrician left to the firm, and it was impossible to get others. The application was postponed for a week for inquiries.

On the application of the private secretary of the Earl of Suffolk, Charles Harvey (31), married, chauffeur and in charge of the electric light plant, has been exempted until April 1st.

Controlled Establishments.—The number of establishments now controlled by the Ministry of Munitions is 4,390, 74 having been added since the last announcement.

BUSINESS NOTES.

Trade Announcements.—On account of the retirement of Mr. J. Rhodes, the business of Messrs. Richards & Rhodes, electrical engineers, of Station Buildings, Keighley, will be carried on in future by Mr. Stephen Richards.

Mr. Harry Moss, of Bradford, announces that, consequent upon the decision of the Military Tribunal, he is making arrangements to settle his business affairs, and is unable to accept any more contracts or orders for work. The following firms, who are members of the Electrical Contractors' Association (Inc.), have undertaken, as far as lies within their power, to carry out any work that would otherwise have been placed in his hands; preference, of course, being given to munition work and breakdowns:—Collinson Bros., Bradford; A. R. Farrar & Co., Bradford; Gath Electrical Engineering Co., Southgate, Halifax; Jessop & Boydell, Ltd., Bradford; Richard Lindley, Shipley; Geo. Newby, Bradford; Smith & Croft, Bradford.

Book Notices.—"British Opportunities in Russia." By L. A. Rojansky. London: Anglo-Russian Translations Bureau. 2d. In this pamphlet the author refers generally to the large extent of the Russian market and the possibilities of trade. A table is given of imports to Russia from Germany, Austria-Hungary and the United Kingdom.

"Principles of Alternating-Current Machinery." By R. R. Lawrence. London: Hill Publishing Co. Price 18s. 9d. net.

"Principles of the Telephone." Part 1, Subscribers' Apparatus. By C. M. Jansky and D. C. Faber. London: Hill Publishing Co. Price 6s. 3d. net.

"Post Office Electrical Engineers' *Journal*." Vol. IX, Part 3. October, 1916. London: H. Alabaster, Gatehouse & Co. Price 1s. net.

The Institution of Electrical Engineers has issued a "Supplement" to the List of Members. It gives the names of the Council and officers for the session, the Committees of Local Sections and Centres, the local honorary secretaries abroad, names of new members, and a list of former members who have ceased their membership under Article 41.

"The *Journal* of the Tramways and Light Railways Association" for October contains a notice respecting the obtaining of certificates from the Ministry of Munitions before purchasing steel, the conclusions (and map) of the National Electric Power Supply Joint Committee, and other matters.

"Scientific Papers of the Bureau of Standards." No. 285. "Summary of Experiments on the Silver Voltameter at the Bureau of Standards, and Proposed Specifications." Washington: Department of Commerce.

"Circular of the Bureau of Standards." No. 60. "Electric Units and Standards." Washington: Department of Commerce.

For Sale.—The Manchester Corporation Electricity Committee has for disposal one 1,800-kw. d.c. generator, direct-coupled to a vertical cross-compound steam engine, and one 3,750-kw. three-phase a.c. alternator, direct-coupled to a vertical triple-expansion steam engine.

The Borough of Salford Electricity Committee has for disposal a quantity of low-pressure cast-iron piping.

Messrs. Shirlaw, Allan & Co., Keith Street, Hamilton, the agents for the Controllers appointed by the B. of T., will sell by auction on Friday, November 10th, at Glasgow, the stock of electrical machinery, office fittings, &c., of the Phœnix Electrical Co., and the Caledon Electrical Co. Particulars appear in our advertisement pages to-day.

Dissolutions and Liquidations.—United Carborundum and Electrite Works, Ltd.—Creditors must send particulars of their debts, &c., to Mr. C. Eves, 62, New Broad Street, E.C., the controller, by November 27th.

Electro-steel Foundries, Ltd., Darlaston.—Liquidator (H. E. Burgess) released October 19th, 1916.

General Engineering Accessories, Ltd.—This company is winding up voluntarily, with Mr. H. Chapman, 2, Farley Road, Catford, S.E., as liquidator.

Liverpool Lighting & Heating Co., Ltd.—This company is winding up voluntarily, with Mr. E. J. Butcher, 344, Gray's Inn Road, W.C., as liquidator.

Western Lighting and Heating Co., Ltd.—This company is winding up voluntarily, with Mr. E. J. Butcher (as above) as liquidator.

Kingston Lighting Co., Ltd.—This company is winding up voluntarily, with Mr. Butcher (as above) as liquidator.

Electrical Oil Refining Co., Ltd.—A meeting is to be held on December 4th at 29, Great St. Helens, E.C., to hear an account of the winding-up from the liquidator, Mr. J. E. Frost.

Messrs. R. Stephenson, A. Drewer and C. R. Curtis, carrying on business as electrical consulting and contracting engineers at 27, Chancery Lane, London, as Drewer, Stephenson & Co., have dissolved partnership. Mr. Stephenson retires from the firm. Debts, &c., will be attended to by the remaining partners, who will continue the business under the same style.

Catalogues and Lists.—British Thomson-Houston Co., Ltd., Rugby.—New list (No. 4,591) of 16 pages, in the company's standard style and size, giving particulars, prices, shipping diagrams and dimensions, &c., of instrument transformers for circuits up to 12,000 volts.

Westinghouse Cooper Hewitt Co., Ltd., 80, York Road, King's Cross, London, N.—Nos. 1 and 2 of a well-produced pamphlet, entitled "Lighting in Photography." The articles contained therein deal with "Lighting the Subject in Portraiture," "Light Source for Enlarging," "Artificial Illuminants for use in Practical Photography," "Control of Expression and Attitude," all going to show the important part played by illumination in photographic art.

General Electric Co., Ltd., 67, Queen Victoria Street, London, E.C.—New Osram folder price list (No. OS 2,061) for enclosure with correspondence or for carrying in the pocket. Correspondence post-cards (in which a small-sized elephant successfully tries a balancing trick on a large-sized Osram, illustrating, of course, the latter's strength), have also been issued for use by the company's customers.

Pope's Electric Lamp Co., Ltd., Hythe Road, Willesden, N.W.—New booklet, entitled "My Life," in which their mascot, "The Elasta Man," is seen in all sorts of situations, each situation pointing a moral to the virtues of "Pope's Elasta British-made wire lamps." Contractors can be supplied with printed copies upon request.

Messrs. Belling & Co. have issued a handy pocket pamphlet, entitled, "Coal Economised: All Drudgery Housework Saved," in which they give small illustrations and prices of a number of patterns of their electric fires, of which over 30,000 have been supplied for ordinary domestic use during the last four years.

Messrs. Credenda Conduits, Ltd., Chester Street, Aston, Birmingham.—Folder, giving illustrations and price particulars of a number of their designs of electric fires, heaters, convectors, and heating and cooking appliances.

Electrical Imports of the Argentine Republic.—The value of the electrical goods imported into the Argentine Republic during the first half of the current year is officially returned at £353,000, practically the same total as during the first six months of 1915.

Australian Inquiries.—The B. of T. Department of Commercial Intelligence (73, Basinghall Street, E.C.) has received information respecting firms in New South Wales who desire to take up agencies for British makers of porcelain insulators, insulator pins, electrical fuses, cut-outs, switches, and other accessories: also arc lamps and accessories, miners' safety lamps, smokeless furnaces, air compressors, air-lift pumps, &c. The reference numbers are 370 and 376.

LIGHTING AND POWER NOTES.

Argentina.—The Municipality of Viedma (Capital of Rio Negro Territory) has decided to install a service of public electric lighting, and has placed the order for the equipment with the Anglo-Argentine General Electric Co., Buenos Aires.

Barking.—Year's Working.—For the year ended March 31st last, the revenue of the Council's electricity undertaking amounted to £12,663, the working and management expenses were £11,217, and, after meeting all financial charges, there was a deficit of £2,998 on the year. A total of 1,263,944 units were sold, being 160,390 less than in 1914-15.

Belfast.—Proposed Extensions.—The Tramways and Electricity Committee at its last meeting considered the increasing demands being made on the electricity department, and the steps to be taken to meet the same. After full consideration, the Committee recommended that the Council should authorise the Committee to take up again the matter of the extension scheme, part of which could be put in hand as soon as the necessary Treasury sanction to the expenditure can be obtained.

Bradford.—The Guardians are to extend the electric mains for the purpose of lighting the whole of the laundry and garage block.

Christchurch.—Price Increase.—With reference to the demand of the Bournemouth and Poole Electricity Supply Co. for an increased charge for current, the B. of G. has decided to pay in accordance with the terms of the contract only.

Continental.—Italy.—Volcanic Heat Stations.—Although, in view of the high cost of coal in Italy, there exists a great stimulation to search for other and more economical sources of energy, it is novel and interesting to learn that the internal heat of the earth in a volcanic district is now being utilised for the generation of electrical energy. From the *Rassegna Mineraria*, of Rome, we learn that a thermo-electric generating plant is already in operation at Larderello, about 12 miles from Volterra. The idea of utilising the available volcanic heat was first put into practice in 1903 by Prince Ginori Conti. At Larderello the heat issues from the earth in the form of jets of steam, which the Prince first attempted to utilise by causing the jets to impinge on bucket wheels. Later, arrangements were made to use the steam directly in a reciprocating engine coupled to a dynamo. Encouraged by the results, he made use of a small part of the steam issuing from one of the largest jets at a pressure of 75 lb. per sq. in., and by this means obtained some 40 h.p. The steam from the jet in question issues at a temperature of about 160° C., and at the rate of 11,000 lb. per hour. The general results were quite satisfactory, except that it was found the acids present in the steam had a corroding effect on the engine. In the meantime, while these experiments were in progress, prospecting operations for new sources of steam were also in progress, with the result that several giving good results were found, including one which furnished steam at a pressure of from 30 to 45 lb., and at the rate of 55,000 lb. per hour, this being utilised to operate a 300-h.p. turbine and alternator, which furnished current to light the borax works at Larderello. This was the position at the commencement of the war, which, owing to the resulting greatly increased cost of coal in Italy, gave an impetus to the further use of the volcanic steam. Indeed, so successful had the experiments been that the Prince placed an order with the well-known Italian engineering firm, Messrs. Tosi & Co., for three steam turbines, each of 5,000-h.p. capacity, coupled to 3,000-kw. alternators. Two of these sets are already installed and in operation, while the third will shortly be added. In this case, however, the steam is not utilised directly, but is used to heat multitubular boilers. The current generated is transformed up to a pressure of 36,000 volts, at which it is transmitted by five different lines to the towns in the neighbourhood.

Russia.—The "Donetz Basin" Co. has commenced the erection of an electric station near the Loboff Kopy station of the Ekaterininsk Railway, to supply current to the mines, factories, towns and industrial centres of the Donetz Basin. The station will serve a radius of 100 versts, and develop 20,000 kw.

France.—The Société Hydroelectrique Drac-Romanche is the style of a company formed at Grenoble to develop more particularly a hydro-

electric station to be erected above the watermeet of the Drac and the Romanche. The capital of the company is 6,000,000 fr.

The capital of the Société Française des Forces Hydrauliques du Rhône has been increased from 4,000,000 to 8,000,000 fr., in consequence of certain financial arrangements with the Société Franco-Suisse pour l'Industrie Electrique.

Norway.—A new carbide manufacturing company, with a capital of 760,000 kr., to be eventually raised to 1,200,000 kr., under the style of the A/S. Kvina Carbide Smelteverk, is announced in the register of new firms. Its works are to be situated between the Fede and Flekke fjords, but power is to be derived from the Trælands waterfall. The output is estimated at first at 6,000 tons yearly.

Dewsbury.—Plant Extensions.—The Electricity and Tramways Committee has submitted to the Council an estimate of work to be carried out after the war, prepared by Mr. R. H. Campion, the electrical engineer, and amounting to £35,800. The principal items are: two 2,000-kw. turbo-alternators and condensers, £14,000; two 500-kw. rotary converters, £4,000; two 250-kw. ditto, £1,250; switchboard, £1,600; cables, £8,400. Mr. Campion also states that when the load exceeds 2,000 kw. an extra boiler will be required at a cost of £3,000; an additional cooling tower, £2,000; and coal conveyors, £1,500.

East Ham.—Year's Working.—Mr. W. C. Ullmann, the Corporation electrical engineer and manager, in his analysis of the electric lighting accounts for the year ended March 31st, 1916, shows a total revenue amounting to £26,709, total operating costs amounting to £20,053, and a gross profit of £6,556. After meeting interest and special charges, £4,375, and sinking fund, &c., £5,705, there is a deficit on the year's working of £3,424, as compared with a profit of £1,130 in 1915. The total number of units sold was 4,162,750; fuel cost, ·61d. per unit, as compared with ·45d. per unit in the previous year. The total operating costs were 1·16d. per unit sold, as compared with ·97d. in 1915. The maximum load was 1,890 kw., and the load factor 27·6 per cent.

Epsom.—The U.D.C. has authorised the electrical engineer to experiment with tar oil for the Diesel engine, owing to its becoming increasingly difficult to obtain American oil.

Glasgow.—Dalmarnock Extensions.—In connection with the decision of the T.C. Committee to proceed with a portion of the new generating station at Dalmarnock, the chief engineer (Mr. W. W. Lackie) reported that in 1914-15, the maximum demand for electric power was 53,000 h.p., and in 1915-16 61,000 h.p.; that for 1916-17 he estimated the maximum demand at 67,000 h.p.; that the normal rate of increase in demand was between 7,000 and 9,000 h.p. per annum; that the limit of the capacity of the boiler and turbine rooms at the existing stations had been reached; and that it was absolutely essential to put down additional plant, which plant would take two years to construct and erect, to meet the demand for the winter of 1918-19. He further reported that the department had on its books 200 applications for supplies not yet connected, which represented an aggregate of 17,000 h.p., and that 15 of these were from very large engineering and shipbuilding works, who asked supplies representing over 8,000 h.p. He thereafter referred to the plans submitted showing the lay-out of the station, and stated that arrangements should be made forthwith for erecting and installing the following works and plant:—(1) Buildings, consisting of boiler house, part of turbine room and switch house, together with concrete work in connection with coal storage yard and coal tipping chute, the estimated total cost being £105,000. (2) Machinery for (*a*) generating station—the first installation of boilers and boiler room accessories, two 20,000-kw. turbo-alternators, relative switchgear, travelling crane and coal-conveying and ash-removing plant, the estimated total cost being £255,100; (*b*) sub-stations—transforming plant to the extent of 18,000 kw. for six sub-stations, the estimated total cost being £72,000; total, £432,100. In addition to the foregoing buildings and plant, the engineer mentioned that it would be necessary (*a*) to put down h.t. mains and cables between the new Dalmarnock Works and the two existing generating stations at Port Dundas and St. Andrew's Cross, at an estimated cost of £60,000; (*b*) to put down low-tension mains during the next three years at an estimated cost of £150,000, and branch mains during the next three years, at an estimated cost of £21,000; and (*c*) to purchase meters for new consumers during the next three years at an estimated cost of £13,500; total, £244,500. He further stated that the major portion of the foregoing expenditure would not be due for payment until the year 1918, and that the unexhausted borrowing powers of the department at May 31st, 1916, amounted to approximately £100,000. The Town Council was authorised to apply for the necessary authorisation for the Corporation to construct the foregoing works, and for authority to borrow £500,000, which, with the present unexhausted borrowing powers, will meet the requirements of the department for the next three years.

Heywood.—The Electricity and Tramways Committee has decided to grant an extension of the supply of energy from November 1st to February 28th to the Albert New Mill Co., Ltd., and is also in negotiation with the Roe Acre Dyeing and Felting Co. for supplying extra-high-tension energy to its premises.

Kilmarnock.—Report.—Sir A. B. W. Kennedy has reported to the T.C. on the advisability of developing the electricity undertaking to supply the area. He confirms the charges made for power, and suggests the advisability of ordering a 3,000-kw. turbine plant, in view of the delay which may occur in obtaining delivery of plant.

Kingston-on-Thames.—In connection with the failure of the compressor of one of the Diesel engines at the electricity works, the insurance company has agreed to pay £40 a week compensation, dating from seven days after the accident until the plant is in running order.

Leek.—The U.D.C. has authorised the levying of a supplementary general district rate of 6d. in the £ to defray that portion of the cost of the new plant of the electricity generating station which has to be paid during the current financial year.

Leigh.—In view of the position which it is placed in by reason of the refusal of the L.G.B. and other controlling authority to sanction a loan for the extension of the electricity works, the Corporation has decided to inform the B. of T. that it reluctantly gives its consent to the Lancs. Electric Power Co. supplying the West Leigh Collieries with electricity, subject to the order proposed to be made by the Board being in the terms set forth in the model form which has been submitted.

London.—Islington.—In consequence of the employés of the electricity undertaking being dissatisfied with a suggested increase in wages, the men are appealing to the Munitions Court for leaving certificates.

Hammersmith.—Bulk Supply.—The Electricity Committee reports the receipt of the B. of T.'s formal order permitting the B.C. to supply electricity in bulk to the Chiswick Electric Supply Corporation.

L.C.C.—The Finance Committee reports that it has agreed to make loans in accordance with the terms of the sanction of the Council of £3,728 to the Battersea B.C. for electricity purposes, and of £650 to the Hammersmith B.C. for the purchase of a site for electricity purposes.

Luton.—Linking-up.—The borough electrical engineer is to act as convener for the South Midlands area in regard to arrangements for interconnection of electric supply undertakings.

Richmond (Surrey).—The B. of G. has considered the proposal of the Richmond Electric Light and Power Co., Ltd., to fix 4½d. as the new standard rate for the lighting supply. It was decided to take no action in the matter.

South Africa.—The Rand Mines Power Supply Co. has made application to the Extraordinary Water Court of the Rand Water Board, to be heard at Johannesburg on Monday, December 11th, for authority to store, and/or use, up to 650 million gallons of water in the storage accommodation to be created by the barrage about to be built by the Rand Water Board.

Stockport.—Bonus.—The manual workers at the electricity works and in the tramway department, whose wages do not exceed 35s. per week, are to be granted a bonus of 2s. a week for the period of the war.

Todmorden.—The abstract of accounts of the Corporation's trading undertakings for the year ending March 31st—issued last week—shows that the departments have not, as a whole, experienced a particularly good year; the electrical undertaking showed a deficit of £1,580. The department which has saved the situation on the year has been that of the motor-'buses, whose surplus is £1,898, and the net profit on the undertakings, as a whole, including gas, water and markets, is about £70.

West Bromwich.—Ash Plant.—The Electricity Committee has had under consideration the present method of dealing with removal of ashes, and has decided in favour of a runway being erected in the boiler house, on which the body of a side-tip wagon could be carried. This would be filled with ashes in the boiler house, placed on a truck outside, and carried on a light railway to the ash mound, thus obviating any rehandling. The estimated cost of the scheme, complete with second-hand tip-wagons and light railway, is £256. The Committee has further decided, subject to the usual sanction, to purchase the materials.

Wimbledon.—The Electricity Committee has recommended that the B. of T. be asked if it considers there is a *prima facie* case for the promotion of the application for a prov. order empowering the Council to supply electricity within the parish of Cuddington.

The electrical engineer has been instructed to keep the Electricity Committee informed of any action taken in regard to the interconnection of electricity supply undertakings which might affect Wimbledon.

Worksop.—The Special Committee appointed to investigate the staffing of the electricity works, reported that the staff now engaged was the minimum number which could be employed to carry on the works efficiently.

TRAMWAY and RAILWAY NOTES.

Aberdeen.—Electric Coal-tipping Wagon.—At a meeting of the Corporation Electricity Committee, the question of purchasing an electric coal-tipping wagon was remitted to a Sub-Committee. It was reported that during September 90,820 more units had been generated, as compared with September last year.

Blackburn.—The T.C. has invited the Accrington T.C. to discuss the rate per car-mile paid to Blackburn Corporation in respect of Blackburn cars running on the Accrington section, with

the suggestion that the present rate should be increased by a reasonable amount. The Accrington Tramways Committee has given instructions for the preparation of a report on the cost and revenue concerned.

Croydon.—As it is not possible to get new rails until some time next year, it has been resolved, having regard to the condition of the tramway track in a portion of the Selhurst Road, to take up rails from the Whitehorse Road section and utilise them in constructing a double line between Selhurst New Road and Selhurst Railway Bridge. The original cost of the work when it was believed new rails could be obtained was £2,156.

East Ham.—The tramway interrunning agreement with West Ham being about to expire, it has been arranged that, pending the execution of a new agreement, the present through-running arrangement shall be continued between the L.C.C., the West Ham Corporation, the East Ham Corporation, and the Leyton U.D.C. · Women conductors are to be engaged at 30s. per week net.

Year's Working.—The analysis of the Corporation's tramway accounts by Mr. W. C. Ullmann, the engineer and manager, for the year ended March 31st, shows a total revenue of £66,884, total operating costs amounting to £53,485, and a gross profit of £13,399. After meeting interest, £4,905, and sinking fund charges, £6,542, there was a credit balance of £1,952, as compared with a deficit of £3,524 in the previous year. The total car-miles run was 1,626,104, an increase of 39,120 miles; the passengers carried numbered 20,427,941, an increase of 1,510,970.

Glasgow.—In reply to complaints by workers as to inadequate car service, the general manager has informed the Tramways Committee that additional cars were being put into service.

Hull.—The tramway manager (Mr. McCombe) reported that the receipts from April 1st to October 21st amounted to £91,645, an increase of £1,468 over the corresponding period of last year. A motion that during the winter months the cars cease running from Vincent Square, on week-days, at 10.45 p.m., and on Sundays at 10.30 p.m., was referred to the manager for report.

Newcastle-on-Tyne.—Year's Working.—The report of Mr. E. Hatton, the general manager of the Corporation Tramways for the year ended March 31st last, shows that 73,000,000 passengers were carried, being an increase of 7½ millions over 1914-15. The gross receipts were £321,498, as compared with £291,195: working costs amounted to £188,128, as compared with £155,177, and the net surplus was £23,860, which has been carried to reserve and renewals fund, which now stands at £77,464.

Since 1907 to the present year the city rates have been relieved by £74,164 directly, and £14,934 indirectly, from the tramways. The female staff in the traffic department now numbers 342. Up to the date of the issue of the report 12 employés had lost their lives in the war, and 370 had enlisted. During the year £13,144 had been provided for war allowances, an increase of £8,500 on the previous year.

South Africa.—The Pretoria (T.) Municipality ran a tramcar for coloured persons only, on all routes for two months. The results showed that the takings had not amounted to one-fifth of the operating cost or one-eighth of the total cost, and instead of increasing they were decreasing. The rate of loss was £2,000 per car per annum. Under the circumstances the service has been discontinued.

A report from the general manager of tramways dealing with the working of the new system of fares, states that the loss due to the altered fares and stages is over £7,000 per annum.

Wolverhampton.—Electric Vehicles.—For the purpose of providing a more efficient means of transit over the tramway system for breakdown work, repairs, testing and supervision, the manager has been authorised to purchase an electric lorry and car at an estimated cost of £370 and £217 10s. respectively.

TELEGRAPH and TELEPHONE NOTES.

Cape-to-Cairo Wire.—British East Africa is now directly connected with South Africa by wire through German East Africa, *viâ* General Northey's route. One link is the German line from Kilossa to Irangi.

French Colonial Cables.—The French Government has laid before the Chamber a Bill to approve an agreement concluded with the Compagnie des Câbles Télégraphiques with the object of prolonging the convention of September 30th, 1889, in relation to the Guyane (Guiana) cable. The convention lapsed on August 3rd, 1916, but, under existing circumstances, it has been impossible to consider the establishment of a wireless combination, and the convention has consequently been extended to December 31st, 1924. This date, according to the preamble to the Bill, is also that upon which will expire the convention signed on June 7th, 1889, for the West Indies, so that the three French Colonies of Guadaloupe, Martinique and Guyane will simultaneously be released in relation to the company which provides their telegraphic communication.

Rules for Cabling.—An American Commercial Attaché has received from the Russian War Censor of Telegraphs a statement containing instructions to Americans who wish to avoid trouble and delays in cabling to Russia. These instructions, which may be useful to others, are:—

1. Make your messages absolutely clear, so that a perfect stranger can make sense of them.
2. Do not use too many figures in comparison with the amount of text. A cipher story can be told in figures.
3. Do not send anonymous telegrams. Sign your full name or the name of your firm.
4. Do not be laconic. Short messages sound very mysterious to the censor. Spend a little more money, and make the story complete.
5. Do not use highly-technical terms—*i.e.*, words not generally known or which cannot be readily found in the dictionary.

Spain.—A wireless service between Germany and Spain has been set up from the central station at Aranjuez to Koenigwusterhausen. The rate charged for messages is 0·25 peseta per word, the same as the ordinary telegraph rate. Messages will be accepted for transmission at any of the Spanish wireless and telegraph stations. Wireless communication has also been recently established between Budapest and Madrid.

Sweden.—It is reported that some of the crew of a German submarine operating in the Bothnian Gulf landed on a lighthouse, and, seizing the telephone, tried to find out the movements of several vessels from Finnish ports, but without success. The *Dagens Nyheter* complains that the Royal Decree of September last forbidding to foreign vessels the use of wireless apparatus while in Swedish territorial waters is not being strictly obeyed. German merchantmen have lately reported the movements of passing Finland traders to submarines, with the result that the ships were immediately caught and sunk.—*Morning Post.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—January 22nd, 1917. Electrical plant (converter, battery, booster, and switchboards) for the Castlereagh Street sub-station, for the Municipal Council. Specification from E.L. Department, Town Hall.*

January 8th. Municipal Council Electric Lighting Department. 33,000-volt switchgear. E.L. Department, Town Hall. Specification 10s. 6d.*

Melbourne.—December 11th. City Council. Supply and erection of coal transporter plant. See "Official Notices" September 15th.

Perth.—November 8th. P.M.G. Accumulator parts (Schedule 527 W.A.).*

New South Wales.—Time for sending in tenders for 50-ton electric overhead travelling crane for Yarra Street power-house, Newcastle, extended to January 3rd.*

Bradford.—November 11th. Stores for the Tramways Department. Tramway Offices, 7, Hall Ings. Deposit £1 1s. (returnable).

Durban.—January 3rd. Corporation. One 3,000-kw. steam turbine, alternator, and condensing plant. Specification No. S. 238; drawing No. P. 597, both at the office of the Borough Electrical Engineer, Municipal Buildings. Deposit £2 2s.

Grenada.—Government. Time for sending in tenders for electric supply at St. George's and suburbs is extended to December 31st. Tenders to Colonial Secretary, Grenada, British West Indies.

Johannesburg.—November 13th. South African Railways Administration. 71,778 tungsten drawn-wire lamps, 19,741 solid-drawn tungsten lamps, and 2,412 carbon-filament lamps.*

November 20th. Corporation. 500 or 1,000 trolley wheels for tramcars (Contract No. 181).*

November 27th. Corporation. 1,000 sets of single-pole, ironclad house-service cut-outs (Contract No. 187).*

November 27th. Corporation. 250 field coils for tramcar motors (Contract No. 192).*

December 20th. Corporation. Automatic pressure regulators for the A.C. turbo-generators at the power station.*

January 3rd. Corporation. Iron axles and bushes.*

December 9th. Corporation. A.C. and D.C. electricity meters and time-switches. Specification (21s. deposit) from Mr. E. T. Price, General Manager's Office, Electricity Supply and Tramways Department, President Street, Johannesburg, W.

Manchester.—November 8th. Corporation Electricity Committee. Spec. 64: Valves, &c., for Bloom Street station. Spec. 66: One hydraulic wagon tipper at Stuart Street station. Specifications, Secretary, Electricity Committee, Town Hall.

November 14th. Corporation Tramways. A steam disinfector. Specifications, Mr. J. M. McElroy, 55, Piccadilly, Manchester.

Newport.—November 6th. Corporation. Rotary converters and switchgear. See "Official Notices" October 27th.

New Zealand.—Dunedin.—January 24th, 1917. Motor-generator, accessories and spares. City Electrical Engineer, Market Street Dunedin.*

Rotherham.—November 16th. Tramways Committee. Six electric double-deck, top-covered cars. See "Official Notices" to-day.

Stalybridge.—Tramways and Electricity Board. Water-tube boilers, mechanical stokers, and cooling towers. See "Official Notices" to-day.

Stretford.—November 21st. Corporation Electricity Works. Twelve months' supply of best Lancashire rough slack coal. Approximate annual consumption, 12,000 tons. Tenders to Chairman of Electricity Committee, Council Offices, Old Trafford.

Walsall.—November 4th. Corporation. Stores for the Tramways Department. Particulars from the Tramway Manager.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Glasgow.—The Tramways Committee has recommended acceptance of offers from the British Westinghouse Co. and the Manchester Armature Repair Co. for motor armature coils. The Thomson-Knox Co. have secured the contract for bells and telephones at the new Govanhill baths and wash-houses.

Ilford.—U.D.C. Crompton & Co., Ltd., £67 11s., 12-H.P. motor and starting panel.

London.—L.C.C. During the three months ended September 30th, the Fire Brigade Committee accepted the offer of the Chloride Electrical Storage Co., Ltd., to supply a battery for use in connection with electrically-propelled fire appliances, at £252; also that of Woolnough, Lang, Ltd., for two motor-generators, at £48, and that of the Jackson Electric Stove Co., Ltd., for 26 radiators, at £58.

The Highways Committee purchased about 33,893 tons of coal for use at the Greenwich generating station, at a cost of £51,087, during the quarter ended September 30th.

The Committee has accepted the offer of the British Westinghouse E. & M. Co., Ltd., for the alteration of existing low-tension wiring, and the provision of a portion of the switchgear for the third additional turbo-generator at the Greenwich generating station, at £2,694; also the tender of the Morgan Crucible Co., Ltd., for the supply of carbon brushes (Class T items, Nos. 1 and 2) during 1916-17.

HAMMERSMITH.—Electricity Committee. 25-H.P. motor: Pooley and Austin, £123.

Newcastle-on-Tyne.—City Council. Hadfield's, Ltd. Tramway junction at Northumberland Street, Blacket Street and Pilgrim Street, £2,250.

Salford.—Corporation. Electricity Department:—
J. Wolstenholme & Son, Ltd.—Steam-exhaust and feed-water piping.

Tramways Committee:—
Halley's Industrial Motors, Ltd.—A Halley two-ton chassis, £558.
Briggs, Jones & Gibson, Ltd.—Uniform clothing for inspectors, motormen, and male conductors for 12 months, £2,104.

Shanghai.—The Municipal Council of the International Settlement has ordered Osram lamps for use for street lighting throughout that Settlement, and the agents of the General Electric Co., Ltd., have just secured this year's contract from the Municipal Council of the French Settlement also.

Walthamstow.—U.D.C. Venner Time Switches, Ltd., 72 10-amp. switches at £4 each, and 80 1½-amp. switches at £2 4s. each.

Wolverhampton.—Electricity Committee:—
Ferranti, Ltd., and Reyrolle & Co.—Extra-H.T. switchgear, £270 and £170 respectively.
Herbert Morris, Ltd.—Crane rails, sole plates, &c., £136.
Reyrolle & Co.—5,000-KW. generator switch-panel, £550.
Gibbons Bros., Ltd.—Additional steelwork for the roof of boiler house, £90.
W. Harrison, Ltd.—Coal and slack to September, 1917.

Tramways Committee:—
E. Allen & Co.—Special steelwork for the track in Queen Square, £338.

FORTHCOMING EVENTS.

Royal Society of Arts.—Fridays, November 3rd and 10th. At 5.15 p.m. At John Street, Adelphi. Chadwick Lectures on "Fatigue and its Effect on Industry and Efficiency," by Professor Stirling.

Institution of Mechanical Engineers.—Friday, November 3rd. At 6 p.m. At the Institution of Civil Engineers, Great George Street, S.W. The Thomas Hawksley Lecture on "The Gas Engineer of the Last Century," by Mr. H. E. Jones.

Salford Technical and Engineering Association.—Saturday, November 4th. At 6.30 p.m. At the Royal Technical Institute. Short papers by members in competition for the gold medal offered by Mr. W. O. Larmuth.

Society of Engineers.—Monday, November 6th. At 5.30 p.m. At Caxton Hall, Westminster, S.W. Paper on "Heating and Ventilating Private Dwelling-houses," by Mr. C. T. A. Hanssen.

Institution of Civil Engineers.—Tuesday, November 7th. At 5.30 p.m. At Great George Street, Westminster, S.W. Address by the President, Sir Maurice Fitzmaurice, C.M.G., and presentation of medals awarded by the Council.

Rontgen Society.—Tuesday, November 7th. At 8.15 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Presidential address.

Institution of Automobile Engineers.—Wednesday, November 8th. At 8 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. Paper on "Electrical Car Equipment," by Mr. A. Ludlow Clayden.

Faraday Society.—Wednesday, November 8th. At 5.30 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. General discussion on "Refractory Materials."

Institution of Electrical Engineers.—Thursday, November 9th. At 8 p.m. At Victoria Embankment, W.C. The Eighth Kelvin Lecture, "Some Aspects of Lord Kelvin's Life and Work," by Dr. A. Russell.

(**Yorkshire Local Section**).—Wednesday, November 8th. At 7 p.m. At Hotel Metropole, Leeds. Opening meeting.

NOTES.

By-product Steam Boiler.—We have received from Mr. George Wilkinson, borough electrical engineer of Harrogate, a letter, the contents of which appear to be of such general interest, that we have obtained his permission to publish the essential portions.

Mr. Wilkinson, after explaining that the Harrogate electricity works are situated in a 300-acre farm, a portion of which is likely to come into the building market after the war, goes on as follows:—

"The large chimney at the electricity works is an eye-sore to the estate, and if this is removed it is reasonable to assume that the value of the land will appreciate an average 6d. per sq. yd., which represents over £30,000. Under these circumstances, the Corporation some time ago requested me to devote attention to smokeless combustion, and as a result of careful investigation and experiment, I have been able to design a boiler with the following characteristics:—

"1. The coal is distilled, tar and ammoniacal liquor being extracted as by-products.

"2. The coke obtained from the coal while incandescent gravitates into the furnace, and is there consumed without smoke.

"3. The gas after being denuded of the by-products is also passed into the furnace under considerable pressure with the necessary air, and burns with a smokeless flame until it enters the retort flue, where it is transformed into radiant heat. This radiant heat is absorbed partly by the retort and partly by the water in the boiler.

"Thus very active steaming surfaces are produced not only in the furnace but upon the whole flue surface. On an average I expect to get from 20 to 25 lb. evaporation per sq. ft. of heating surface. The boiler is automatically fed with coal, which passes through the various stages of distillation and combustion automatically.

"It is expected the boiler will furnish superheated steam by reason of a special arrangement inserted in the boiler itself. The boiler makers' opinion of the boiler is favourable, especially as regards its simplicity and cheapness of construction.

"I have little doubt when the boiler is built and successfully tested, the Corporation will be quite prepared to put in two boilers in place of the large Lancashire boiler which we have recently sold. I calculate that twice or three times the amount of steam produced by the ordinary shell-type boilers per sq. ft. of boiler floor will be furnished by my boiler. Due to the smokeless combustion, no chimney stack will be required; induced draught fans will be employed instead of a chimney stack.

"I am aware there are schemes spoken of for the distillation of coal in large power houses, but under the present methods the capital outlay necessary to provide plant which is now in the market is absolutely prohibitive, having regard to the commercial aspect of the question.

"Electrical and mechanical engineers, as a rule, know little of the subject of the distillation of coal, while gas engineers, who are skilled in the art, know little of boiler-house practice. Thus it comes about that there is no plant at present available for coal distillation and steam raising at a reasonable price or of convenient and efficient design.

"Furthermore, the prevailing idea that coal distillation and steam production can be economically carried out successfully on a very large scale only, will be dispelled when closer attention is given to the problem, provided the power-station engineer is wise enough to dispose of his crude products to firms who prepare the various useful commodities therefrom for which there is a ready and increasing demand.

"When this possibility is realised, there will be less fuss made about 'linking-up,' which is the fashionable subject of the hour, and which is largely based upon the assumption that super-stations, preferably established on the coalfields themselves, are alone able to produce economical results, by-products of coal, and low costs of production."

Linking-up of Electrical Undertakings.—A meeting of representatives of municipal and private electrical undertakings of Yorkshire, in connection with the B. of T. interconnection scheme, was held at the Leeds Philosophical Hall on Wednesday last week, Mr. Thos. Roles (Bradford) presiding; 38 of the 40 Yorkshire undertakings were represented, and of the 40, 30 are municipally managed. The County Committee appointed consisted of Messrs. E. Cross (Rotherham), S. E. Fedden (Sheffield), C. N. Hefford (Leeds), Jewell (Yorkshire—West Riding—Electric Tramways, Wakefield), S. D. Jones (Batley), H. A. Nevill (Wakefield), E. S. Rayner (Doncaster, also representing Barnsley), T. Roles (Bradford), H. Webber (Keighley), Geo. Wilkinson (Harrogate), W. B. Woodhouse (Yorks. Electric Power Co.), and Mr. W. M. Rogerson (Halifax) as hon. secretary. The Leeds and Bradford Corporations favour the scheme; the Shipley Council has signified its inability to see any advantage to Shipley, but was represented at the meeting.

Inquiries.—Makers of *red* ebonite rod are asked for.

Copper Prices.—Messrs. F. Smith & Co. and Messrs. James & Shakespeare report:—November 1st: No change in prices quoted last week.

Some Switching Problems.—Messrs. A. P. Lundberg and Sons, Liverpool Road, Holloway, London, N., send us the following interesting problems in electric-light switching. Any of our readers who care to work out the answers, and post copies of them to Messrs. Lundberg at any time during this month, will be informed by them as to the success or failure of their efforts.

The answers may be worked out with the help of any book on lighting or wiring that bears on the subject; and over-sea readers may send in their answers at any time.

PROBLEMS.

1. A single-way switch controls four lamps—1, 2, 3 and 4. What alteration would you make to enable either 1 and 3, or 2 and 4, or all the lamps, to be switched on?

2. A pendant lamp hangs from a rose in the centre of the ceiling, and is controlled by a switch in its holder. It is now desired to dispense with the holder switch and operate the lamp from two pendant two-way switches. In thus converting the control from single-way to two-way, it will be necessary to alter the ceiling-rose. No other disturbance of the fixed wiring will be necessary, since the two switches are to be connected by flex. all the way to the rose, the flex. passing through insulated screw-eyes. Sketch the circuit.

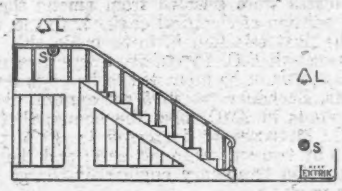
3. Two three-light pendants are controlled by a "Twinob" switch. One arm of the switch turns on a lamp in each pendant. The other arm lights the other two lamps in each pendant. All the lamps are alight when both arms of the "Twinob" are on.

(*a*) Sketch the connections in a simple diagram.

(*b*) Show the same connections in the plan of a room.

4. A lamp A is controlled by an ordinary or single-way switch, A S, and another lamp B by a similar switch, B S. It is required to replace A S and B S by two-way switches, so that A and B can be turned on and off together at either switch point. Make a diagram showing how you would effect this alteration in the control with the least possible alteration of the original wiring.

5. In the adjacent sketch of a hall and stairway, S S represent switches and L L lamps. What different arrangements would be



possible with these switches and lamps, and what would be their relative advantages?

6. A contractor once wrote saying that, though he had connected the wires at an intermediate switch both crossed and uncrossed, he was unable to get it to work properly. Explain carefully what mistake was made.

7. When an ordinary two-pin plug connection is fixed low down on a wall or on a skirting board, why is it better to place it with the pins and sockets in a vertical line, instead of in a horizontal line?

8. A room with a door at each end is to be fitted with two-way intermediate control from three points. A switch is to be fixed by each door, and a pendant switch midway. Map out the wiring between the switches on the assumption that it is preferred to have the pendant switch two-way instead of intermediate.

The Smithfield Fire.—Our reporter who attended the sitting of the City of London Tribunal when the applications of the Smithfield Markets Electric Supply Co., Ltd., for exemption of a number of members of the staff were heard, was apparently hard of hearing, or else he confused his shorthand signs for "dozens" and "thousands." In our last issue he led us to credit Mr. S. M. Powell, the manager and secretary of the company, with saying that the electrical papers contained "thousands" of advertisements for shift engineers. We, of course, were aware of central station chiefs' difficulties when the military authorities have cast envious eyes at the robust figures of their staffs, and we recognised that large numbers of them were wanting experienced men whom they could not secure, but thinking that "thousands" was a little extravagant, unless you added all the journals for a year together, we ventured parenthetically to express our unbelief. Of course, we were quite prepared to hear that we were not the only pebble on the beach, and that we had overlooked the small advertisements appearing in our contemporaries—it is so easy to do so at any time, and particularly in these days when one is busy. However, we learn now that neither was Mr. Powell's statement extravagant, nor were we guilty of "overlooking," for what Mr. Powell really said was "dozens," and not "thousands" at all. As he, in writing to us, says:—"The word used was *dozens*, a number obviously as true as the larger one is absurd." Of course, dozens is far nearer to the mark, and we regret that Mr. Powell should, in days when deaf men are in demand for the Army, have been misheard. Mr. Powell also asks us to correct the statement made in our issue of October 20th respecting the fire at the station. We stated that an explosion occurred, but we are now informed that that was not so. Our information was based on the statements appearing in the *Meat Trades Journal*, from which we quoted.

Excess Profits Duty.—The *London Gazette* for October 31st contains a number of Orders issued under the Finance (No. 2) Act, 1915, Part III, Excess Profits Duty (Sec. 42 (1)). One relates to the application of the Tramways and Light Railways Association for an increase in the statutory percentage as respects the trade or business of tramways and light railways in Great Britain and Ireland where such tramways or light railways are running wholly or in large part over public roads or streets. The Commissioners of Inland Revenue order an increase to 7½ per cent. in the case of companies or other bodies corporate, and 8½ per cent. in the case of any other trade or business. In respect of two applications made by the Melbourne Electric Supply Co., Ltd., and another respecting electricity supply and tramways in Victoria, the same figures—7½ per cent. and 8½ per cent.—are conceded; and in the case of electricity supply and electric traction in India (Mr. Sydney Morse's application), the figures are increased to 7 per cent. and 8 per cent. respectively.

As already notified in these columns, the electric supply companies of the country are appealing to the Board of Referees on the ground that, as a class, they are entitled to special consideration on account of the limitations and restrictions under which they are working, and the fact that in the early stages of the undertakings it is impossible to earn an adequate return upon the capital expenditure involved, it being necessary, in fact, at all times to expend money in advance of adequate return. The petitions claim an increase in the statutory percentage allowed under the Finance Act. The interlocutory meeting was held recently before Sir Charles Renshaw, chairman of the board, at which the course of procedure and certain principles were settled. Mr. H. B. Renwick is representing certain London electric supply companies and a large number of provincial undertakings, and Mr. W. F. Fladgate is representing other London undertakings; together practically the whole industry will be represented. The result will be awaited with great interest by the industry, as a matter of important principle is at stake, and one which cannot but affect the financial position of supply undertakings in the future.

The Concordia Electric Wire Co., Ltd.—We learn from the Concordia Electric Wire Co., Ltd., that they have received an anonymous communication with reference to their advertisement in our issue of last week, in which the writer suggests that the "place is being kept warm for Germans after the war." The company stated in their advertisement that the concern was now composed entirely of British shareholders, the enemy shares having been acquired from the Board of Trade. They now ask us to state that, far from their being "kept warm for the Germans," they are preparing for taking their place amongst other British companies to fight the German competition when the war is over. A return is being filed at Somerset House which should convince anyone who cares to make the usual search, that the shareholders are entirely British. "The whole of the present directorate and managing staff are absolutely British born."

A National Gas Council.—A National Gas Council, comprising the governing bodies of all the existing organisations in the gas industry (including the British Commercial Gas Association), has been established to deal, as they arise, with matters of importance and urgency that concern all sections of the industry, and call for united action on its behalf.—*The Times.*

Our Commercial Intelligence.—The *Daily Telegraph* states that Mr. Runciman hopes to be able to make an announcement shortly on the question of the improvement of our existing machinery for the collection of commercial intelligence, and for promoting British trade over-seas.

The Electrification of Wool.—An important discovery has been made by Dr. S. A. Shorter, who is conducting the research into the problem of the electrification of wool and other textile fibres, at Leeds University. It appears that the friction to which the fibres are subjected is not, as was supposed, the only cause of the electrification of wool; electrification is also caused by drying, followed by lowering of the temperature. This entirely new discovery is one of the first results of the research instituted under the auspices of the Textile Institute.

Appointments Vacant.—Engineer (Rs. 800), for the Lahore Electric Supply Co.; three assistant electrical engineers for the Government of India; temporary chief clerk (£140), for the Aberdare U.D.C. electricity and tramway department; tramcar-shed foreman for Rhondda Tramways Co. See our advertisement pages to-day.

Fatalities.—W. H. Connor, a wire-jointer's mate, aged 53, was killed by falling through a trap-door on to a concrete floor 9 ft. below, while engaged on an electrical installation job in King Street, Warrington. Verdict, "Accidental death," with a rider that a fence should be put around the trap-door.

John Hall (15), Parker Street, Brierley Hill, was killed on Monday, last week, at Earl Dudley's Old Level Works, Brierley Hill. The evidence at the inquest showed that the lad was playing with other boys, after supper, when he caught hold of an electric lamp-post, with the result that his clogs became fastened in the wires, one of which he held by his hand. The current was immediately switched off, and the boy released. Artificial respiration was resorted to, but without avail. The voltage was 100 volts A.C., whereas, according to the Home Office Regulations, a voltage of 125 was safe. Verdict, "Accidental death."

Kinema Operators.—The increasing tendency to employ youthful persons as operators and mere children as assistant operators in London kinematograph theatres has been reported upon by the Theatres and Music Halls Committee of the L.C.C. The Committee says:—"In view of the extent to which the safety of the public attending a kinematograph display depends on the skill and presence of mind of the operator, we think that the employment of youthful operators should be prohibited by the terms of the Council's licence, notwithstanding the difficulty now being experienced in obtaining suitable adult employés. The employment of boys and girls over (say) 14 years of age for re-winding films and for assisting the operator, does not involve so much risk, either to the audience or to the individual, provided that the responsible charge operator is always present in the operating enclosure, and that the re-winding room adjoins the operating enclosure; but such persons could not be entrusted with certain of the electrical apparatus (such as motor generators on high-voltage circuits) without risk to themselves and to the installations." The Committee recommends:—"That all licences granted by the Council in future under the Cinematograph Act, 1909, be subject to a condition as follows:—That the operating enclosure shall be in the charge of a competent operator, who shall be not less than 18 years of age, and shall be present in the enclosure during the whole time that the machine is being operated."

Institution and Lecture Notes.—University College (University of London).—On Friday last Prof. J. A. Fleming commenced a series of lectures on "Long-distance Telephony." After a brief preliminary explanation of the use of the operator j in such expressions as $\cos\theta + j\sin\theta = \epsilon^{j\theta}$, he discussed the nature of sound-waves, illustrating the production of a sinusoidal wave-form with the aid of a simple harmonograph. The nature of the vibrations of a telephone diaphragm was next discussed, and it was shown that the natural frequency of its fundamental vibration was in the neighbourhood of 1,000 per second; as the frequency of speech vibrations adopted as a standard in telephony was 800, it was obvious that the frequency of the diaphragm was inconveniently close to that of the vocal standard, as the natural period of the diaphragm affected the wave form. The nature of the waves produced in a telephonic circuit by the human voice was demonstrated by means of oscillograms, which showed that in the case of vowel sounds the vibrations were periodic and continuous, but the consonants produced "explosive" oscillations which were strongly affected by the natural period of the diaphragm. Hence it would be a great advantage if the diaphragm frequency were nearer 8,000 than 800, and in the human ear this condition was fulfilled. the fundamental vibration frequency of the diaphragm of the ear being about 5,000, so that the ear could distinguish very fine differences in sounds.

After explaining the harmonic analysis of complex periodic curves by Fourier's theorem, Prof. Fleming said that Lord Rayleigh and König were of opinion that the ear was more sensitive to the phase differences of the components of a sound-wave than to differences of amplitude; the lecturer, however, believed that the amplitudes of the components were the more important factors. Rayleigh found that an amplitude of vibration in air of $\frac{1}{800000}$th mm. was just audible, and this was confirmed by Max Wien; the latter also showed that the least audible motion of the diaphragm had an amplitude of $6{\cdot}3 \times 10^{-10}$ cm.—far smaller than the wave-length of light (5×10^{-5} cm., green), and comparable with the dimensions of a molecule.

After touching upon the qualities of carbon which made it particularly suitable for the construction of transmitters, Prof. Fleming passed on to explain the effect of the line on the wave-form of a telephonic current, showing that, as the shortest waves travelled fastest and attenuated most quickly, they tended to disappear and leave only a sinusoidal wave. The four primary qualities of the line which were in operation were the inductance, capacity, resistance, and leakance, in addition to which there were four secondary qualities the vector impedance and admittance, the propagation constant, and the line impedance. The lecturer illustrated the mode of propagation of an electromagnetic wave along a line with diagrams, showing that in the case of a wave reflected at the end of an open line the magnetic force was reversed, whilst when reflection took place at a closed end the electric force was reversed. He then dealt with the mathematical expressions for the voltage and current in a line, which provided the necessary means of calculating precisely what would take place at the receiving end, obtaining the equations—

$$d^2 v/dx^2 = (R + jpL)(S + jpC)\,V = P^2 V,$$

$$V = A\epsilon^{Px} + B\epsilon^{-Px},$$

and similar equations for I. in which four equations, he said, the whole theory of telephony was embodied.

Institution of Electrical Engineers.—The following arrangements are announced for the London meetings of the Institution:—

November 9th.—The eighth Kelvin Lecture, "Some Aspects of Lord Kelvin's Life and Work," by Dr. A. Russell.

November 23rd.—"The Parallel Operation of Electric Power Stations," by J. S. Peck.

December 14th.—"Colonial Telegraphs and Telephones," by R. W. Wightman.

January 11th.—"Principles Involved in Computing the Depreciation of Plant."

Arrangements for the meetings of February 8th, March 8th, and April 19th will be announced later.

Institution of Automobile Engineers.—At the meeting to be held at the Royal Society of Arts, on Wednesday next, at 8 p.m., a paper by Mr. A. Ludlow Clayden, entitled "Electrical Car Equipment," will be read. The chair will be taken by the President, Mr. L. A. Legros. Cards of invitation to the meeting may be obtained on application to the Secretary, Institution of Automobile Engineers, 28, Victoria Street, Westminster, London, S.W.

Institution of Mechanical Engineers.—On October 20th a paper on trials of a Diesel engine, by the late Lieut. F. Trevor Wilkins, was read. The experiments were carried out at the University of Birmingham, and Prof. Burstall's energy diagram was used to enable a heat-balance to be struck. A special form of diaphragm optical indicator, in which the diaphragm was maintained at a constant temperature, was employed. The thermal efficiency obtained by the energy-diagram method ranged from 47·7 per cent. at half load to 42·5 per cent. at full load; the heat lost to the jackets was 24 to 25·3 per cent., and the heat lost to exhaust was 28·3 to 32·2 per cent.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The Special Finance Committee of Walthamstow U.D.C. has decided in favour of a number of increases of salary and wages, including the following:—Electricity Department: G. J. HOLLYER, £40 per annum; A. E. THOMAS, £15 per annum; T. F. LYMN, £25 per annum; G. W. STUBBINGS, £10 per annum; W. G. GARDNER, £10 per annum. Tramways Department: J. W. BAKER, £7 per annum; G. F. UPCOTT, £10 per annum.

The Todmorden Corporation has granted an advance of £25 in the salary of the electrical engineer, Mr. JOSEPH BOYCE.

The Ilford tramways manager's salary is to be increased from £460 to £480 a year.

Eight candidates were selected from among the 106 applicants for the position of electrical engineer to the Wigan Corporation. The final selection is to be made this week.

The Hammersmith B.C. Electricity Committee recommends that Mr. J. HORSBURGH be promoted to be engineer-in-charge, in place of Mr. Buchanan, at £175 per annum, rising by two annual increments to £200, plus the bonus; that the salary of Mr. F. G. MUNTZER be increased to £175 per annum, rising to £200 by two annual increments; and that Mr. F. L. FITCH be appointed temporary engineer-in-charge at a salary of £3 5s. per week.

General.—Mr. J. H. WILD, who has been with the Lancashire Dynamo & Motor Co., Ltd., Trafford Park, Manchester, since it started, severed his connection with the company on October 31st, 1916, and on the following day joined the electrical department of Messrs. Vickers, Ltd. His address is now: c/o Messrs. Vickers, Ltd., Electrical Department, Vickers House, Broadway, Westminster, S.W.

London Gazette Notice.—Territorial Force. Royal Engineers. London Electrical Engineers. Sergeant F. GOBLE to be Second-Lieutenant (on probation). Sergeant R. FRANCIES to be Second-Lieutenant (on probation). Acting Lance-Corporal C. S. SILVA to be Second-Lieutenant (on probation).

London Gazette Notice, October 13th, 1916.—Army Ordnance Department. Temporary Inspector of Ordnance Machinery, third class, and Hon. Lieutenant C. F. D. SUGGATE to be Temporary Inspector of Ordnance Machinery, second class, and Hon. Captain while holding a special appointment, dated from May 27th, 1916.

Alderman J. MILES, J.P., Chairman of Bolton Corporation Tramways Committee, has been appointed vice-president of the Municipal Tramways Association.

Mr. E. A. LAMBERT, of Walton-on-Naze, electrical engineer to the Coast Development Corporation, who is a member of the U.D.C., has been gazetted Second-Lieutenant in the Inland Water Transport Section of the Royal Engineers.

Mr. ALFRED HOARE, of Messrs. Hoare & Co., bankers, has been elected on the board of the Notting Hill Electric Lighting Co., in the place of the late Sir Richard B. Martin, Bart.

Mr. M. SHORT, of the Newcastle-on-Tyne Electric Supply Co., Ltd., has been re-elected president of the North-East Coast Association of Chartered Secretaries.

The Council of the Institution of Electrical Engineers have elected Prof. GEORGE CAREY FOSTER, LL.D., D.Sc., F.R.S., past president, to be an Honorary Member of the Institution.

Roll of Honour.—The General Purposes Committee of the L.C.C. reports the names of the undermentioned employés of the Council's tramways department who have lost their lives on war service:—

Private C. H. Barnes, East Surrey Regt. (rotary assistant); Corporal G. Bull, East Surrey Regt. (conductor); Lance-Corporal H. A. Cole, Dorsetshire Regt. (fitter); Private E. J. Davies, Royal Welsh Fusiliers (conductor); Corporal G. Dormon, Hampshire Regiment (conductor); Gunner W. C. Howard, R.F.A. (motorman); Driver M. Humphrey, R.F.A. (conductor); Gunner E. C. Laver, R.F.A. (conductor); Private F. Pearce, Royal Welsh Fusiliers (motorman); Sergeant F. C. Pocock, Worcestershire Regiment (motorman); Rifleman W. C. Walter, Rifle Brigade; Private S. V. Scott, Royal Welsh Regiment (conductor); Sergeant J. E. Simons, East Surrey Regiment (conductor); Corporal C. A. W. Walpole, R.F.A. (point adjuster).

The *Times* "Deaths" Column contains the following notice:—"WHITLEY.—On May 31st, of illness contracted abroad, Philip Harold Whitley, Private, E. Surrey, late of the Staff of Electricians, G.P.O."

Rifleman Bertram Oakley, London Regiment, killed in action, aged 28, was engaged with Messrs. Siemens, of Charlton.

Rifleman H. E. Lister, Rifle Brigade, who was at Rugby with the British Thomson-Houston Co., Ltd., has been awarded the Military Medal for gallant conduct in continuously carrying messages under heavy fire on September 4th and 5th last.

Second-Lieutenant Arthur Scragg, attached to the Rifle Brigade, who was before the war an electrical engineer at Rugby, is in the Bristol Royal Infirmary wounded.

Private Henry Coulter, West Yorkshire Regiment, who has died from injuries received when a trench fell upon him, was engaged in the Huddersfield Corporation tramways office.

Private Harry Gladwin, who was in the electric wire department at Messrs. Patchett's Sedburgh Mills, Halifax, has been killed in action, aged 19.

Private Thomas Goodman, of the Manchester Regiment, killed in action, was on the staff of Messrs. Siemens, of Stafford.

Private A. S. Dobbs, of Liverpool, who has been killed at the age of 22, was in business as an electrical engineer.

Sapper G. Cook, who has been wounded, was employed at the Bath electric light station.

Private W. Jackson, Loyal North Lancs., who has been killed, was employed at the works of Dick, Kerr & Co., Ltd.

Private Harry Lightfoot, who was employed in the Leeds Corporation electricity department, has been killed in action.

The death, in action, of A. D. J. Gregson, Gordon Highlanders, at the age of 19, is reported. He was employed by the Automatic Telephone Co., Ltd., at Liverpool.

Second-Lieutenant A. P. E. Prescott, Machine Gun Corps, who has been killed in action, was employed in the Liverpool Corporation electrical department.

Private Eric Pearce, of the King's (Liverpool) Regiment, has been severely wounded. He was employed by Messrs. Bottomley & Frampton, electrical engineers, of Blackpool.

Private A. S. Fussey, of the King's Own Scottish Borderers, who has fallen in action, was with the British L. M. Ericsson Telephone Co., of Beeston.

Sergeant H. W. Atkinson, Duke of Wellington's West Riding Regiment, who has fallen in action, enlisted whilst at Halifax with the United Electric Car Co., for whom he had travelled for nine years. He was 43 years of age, was gassed in Flanders in May, 1915, and on recovering served at the Dardanelles, later returning to France.

News has been received that Rifleman W. E. Mitchenall, London Regiment, formerly on the general office staff of the India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd., Silvertown, was killed in France on September 18th. A good number of "Silvertown" men are serving in the various theatres of war, and many old employés have fallen in action.

Sapper George Howlett, who was electrician at Kelloe Colliery, has died from wounds received in action.

Obituary.—Mr. Charles Harrison.—By the death of Mr. Charles A. Harrison, at Hexham-on-Tyne, on October 28th, a well-known North Country engineer, has been removed. Mr. Harrison was a native of India, being born in Madras in 1848. His uncle, the late Mr. T. E. Harrison, was chief engineer to the North-Eastern Railway Co., and was associated in the work with Robert Stephenson, and upon leaving college Mr. C. A. Harrison entered his uncle's office to be trained as a civil engineer. He later became intimately connected with the N.E.R. Co., and was resident-engineer at the Hartlepools for about ten years, during a period when important developments were made. Upon the death of Mr. T. E. Harrison, in 1888, the company's directors decided to divide the system into two divisions, and Mr. C. A. Harrison was appointed engineer of the northern division. Many very important works were carried out under Mr. Harrison's guidance and from his schemes, and these included the electrification of the coast line. Mr. Harrison had been living in retirement about a year prior to his death, but maintained his connection with the N.E.R. Co., as consulting engineer.

Sir Joseph Beecham.—Sir Joseph Beecham, who passed away last week at the age of 68 years, was a director of the Lancashire Light Railway Co., the Lancashire United Tramways, Ltd., the South Lancashire Electric Traction & Power Co., Ltd., the South Lancashire Tramways Co., and the West Cumberland Electric Tramways Co.

Mr. A. H. Howard.—We regret to learn of the death, which occurred at 64, Victoria Street, S.W., on Wednesday, of Mr. Albert Harris Howard, A.M.I.C.E., M.I.E.E., secretary of the Cable Makers' Association. Mr. Howard was 54 years of age. He had been a sufferer for many years, and had been confined to bed for some time. A month previous to his death he had relinquished his position as secretary of the above Association. Mr. Howard was associated with Mr. Henry Edmonds and the late Mr. Glover, of the firm of W. T. Glover & Co., in the early cable-making days. After the death of the late Mr. Glover and the conversion of his business into a limited company, Mr. Howard became one of the first directors. It was during this period that the Cable Makers' Association was founded, and he became its first secretary. After Mr. Howard left the board of W. T. Glover and Co., Ltd., and entered into practice as a consulting engineer he remained secretary of the Association, and for some years past he has devoted all his time and attention to its growing work.

NEW COMPANIES REGISTERED.

Russo-British Chamber of Commerce in the United Kingdom, for the Promotion of Commerce Between the British and Russian Empires (Incorporated).—This company was registered on October 23rd as an association limited by guarantee, not formed for the purpose of profit, the word "limited" being omitted from the title by licence of the Board of Trade. For the purpose of registration, the number of members is declared not to exceed 2,000, each being liable for £3 in the event of winding up. The general objects are as indicated by the title. Among other means mentioned are the collection and dissemination of statistics, the promotion of the interests of Russian subjects in the British Empire and *vice versa*, and arbitration in settling commercial disputes between British and Russian subjects. All questions of party politics, general or local, are rigidly excluded from the scope of the Chamber. The annual subscription for individual members is not less than two guineas. The subscribers to the memorandum and articles of association are: Sir Algernon F. Firth, Bart., Holme House, Lightcliffe, Yorks.; L. A. Martin, 20, Herne Hill, S.E., sugar refiner; A. Heyking, Imperial Russian Consul in London; F. H. Barker, Lowndes House, Lowndes Place, S.W., director of Vickers, Ltd.; W. A. Robinson, 36, Tooley Street, S.E., managing director of Anglo-Continental Produce Co., Ltd.; T. Doukhovetski, 11, The Waldrons, Croydon (Petrograd Telegraphic Agency); N. N. Wenevitinoff, 61, Ridgmount Gardens, W.C. (manager, The Trading Co., successor to Alex. Goobkin, A. Koonetzoff & Co., 33-5, Fascheap, E.C.); L. P. Rastorgueff, 80, Marchmont Street, W.C., Russian barrister; A. P. Poliakoff, 36, Park Drive, Golder's Green, N.W. (manager, Tea Trading Co., Kn. C. Popoff Bros., 21, Mincing Lane, E.C.); V. V. Schaposchnikoff, Broom Warren, Broom Road, Teddington, general merchant; S. Learie, 98, Great Tower Street, E.C. (manager of Luralda, Ltd.); W. S. Guild (Mather & Platt, Ltd., Queen Anne's Chambers, S.W.); D. Ghambashidze, 61, Mark Lane, E.C., merchant. There are to be separate British and Russian sections. The management is vested in an executive council, to consist of (1) the patron or patrons, the honorary president, the four honorary vice-presidents, the president, the vice-president, and the chairman and vice-chairman of the British and Russian sections, all *ex officio* members, and (2) eight British and eight Russian elected members. Until the first general meeting, the above subscribers are to form the council. The hon. president is to be the Russian Ambassador for the time being, and the four hon. vice-presidents are to be the Russian Consul-General in London, the Russian Commercial Attaché in London, and the president of the Association of Chambers of Commerce of the United Kingdom or their nominees or substitutes, and one other to be elected at the annual meeting. The president and vice-president are to be elected by the executive council, provided that if the president is of British nationality the vice-president must be Russian, and *vice versa*. There is also to be a general council, to consist of the Russian State Consular Officers in the United Kingdom and such other honorary or subscribing members as the Council shall elect. The members of such general council are to have the ordinary privileges of members, but (as a council) no control over the Chamber. The solicitors are C. Urquhart Fisher and Co., Cecil House, Holborn Viaduct, E.C. Secretary: D. Ghambashidze. The registered office is at International Buildings, Kingsway, W.C.

New London Electron Works, Ltd. (145,161).—This company was registered on October 26th, with a capital of £15,000 in £1 shares, to take over the business of the London Electron Works Co., Ltd., to carry on the business of iron, steel, lead, brass, and metal masters, makers and converters, smelters, founders, metallurgists, electrical and electrochemical engineers, &c., and to adopt a contract between A. Taylor, F.C.A., receiver for the debenture-holders of the said old company, and Geo. Cohen, Sons and Co., being a tender by the latter and acceptance by the former. The subscribers (with one share each) are: B. Cohen, 600, Commercial Road East, E., new and old iron merchant; J. B. Batchelor, 2, Pancras Lane, E.C., solicitor. Private company. The number of directors is to be six; the first are B. Cohen (chairman), M. G. Cohen, L. Levy, J. B. Batchelor, H. W. Robinson, and C. T. Batchelor. If either of the three first named vacate office, George Cohen, Sons & Co. may appoint a successor. If either of the three last named vacate office, Batchelor & Co., Ltd., may appoint a successor. Remuneration as fixed by the company. The customary declaration to the effect that the company is not formed for the purpose or with the intention of acquiring all or part of any business, the books and documents of which are liable to inspection under the Trading with the Enemy Act, has been filed. The Memorandum of Association contains various provisions for safeguarding the British character of the company. Solicitors: Harris, Chetham & Cohen, 25, Finsbury Square, E.C.

British Miniature Electric Vehicles, Ltd. (145,135).—This company was registered on October 23rd, with a capital of £5,000 in £1 shares, to carry on the business indicated by the title, and that of engineers, contractors, &c., and to adopt an agreement with W. Bleakley and S. W. Copley. The subscribers (with one share each) are: C. W. Copley, 50, Cornhill, E.C., pastoralist; J. S. Jeffries, 50, Cornhill, E.C., cashier. Private company. S. W. Copley is permanent managing director, and may act with or without ordinary directors. Qualification of ordinary directors, £100; none required for governing director. Remuneration of governing director as fixed by the company. If S. W. Copley die while holding the office of governing director, he may appoint a successor by will, or, in default, his exors. may, while holding one-quarter of the issued capital, appoint a successor. Solicitors: Lawrence Webster, Messer & Nicholls, 14, Old Jewry Chambers, E.C.

London Lorries, Ltd. (145,137).—This company was registered on October 23rd, with a capital of £5,000 in £1 shares, to carry on the business of builders and repairers of steam or electric motors, lorries, and cars, &c. The subscribers (with 10 shares each) are: C. J. H. McRea, Nideen, Mill Hill, Middlesex, merchant; F. C. Bradshaw, 87, St. Gabriel's Road, Brondesbury, N.W., merchant; R. Tozer, 1, Granville Road, Stroud Green, N., merchant. Private company. The number of directors is not to be less than two or more than five; the first are C. J. H. McRea, F. C. Bradshaw, and R. Tozer (all permanent). Qualification, £10. Remuneration as fixed by the board. Registered office: Bush Lane House, Cannon Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Willans & Robinson, Ltd.—Mortgage dated October 16th, 1916, to secure floating balance not exceeding £12,700, charged on moneys due to the company under a contract with the Keighley Corporation. Holders: Lloyd's Bank, Ltd.

CITY NOTES.

Auckland Electric Tramways Co., Ltd.

For the year ended June, 1916, the total revenue was £280,876. The traffic receipts were £274,784, an increase of £6,990. After providing for all expenses chargeable to revenue, including £21,056 for debenture and other interest, the rental and percentage of profits payable to the Auckland City Council amounting to

£5,545, and setting aside £25,000 to the renewals and depreciation account, there is a surplus on the year's working of £54,570, plus £4,655 brought forward, making £59,226. After paying the preference dividend, transferring to reserve £10,000 (making it £132,500), and paying a total of 1s. 7d. per share on the ordinary shares, £4,601 is to be carried forward. £6,345 first mortgage debenture stock was bought and cancelled, the average cost to the company being approximately 94¼ per cent. The capital expenditure during the year was £10,884, chiefly for the now practically completed Upper Queen Street extension. A poll taken regarding the running of cars continuously during Sunday evenings showed a large majority in favour thereof, and the service has since been maintained with satisfactory results. The route miles open have increased from 25.42 to 26.59; the passengers carried increased from 41,375,689 to 42,352,534; the average receipts per passenger advanced from 1.55d. to 1.56d.; the average expenditure was .99d:, the proportion of expenditure to receipts 64 per cent., and the number of cars 166, for both years.

The annual meeting was held in London on Tuesday.

Western Telegraph Co., Ltd.

The revenue for the year ended June, 1916, was £982,248, and the working expenses were £362,295. After providing £32,747 for debenture stock interest and £138,397 for income-tax and excess profits duty, £448,809 remains, plus £85,880 brought forward. £100,000 has been applied towards further reduction of capital expenditure in excess of share capital and debenture stock issued, £100,000 transferred to general reserve fund, £30,000 to the land and buildings depreciation fund, and £100,000 to the provision on account of investment fluctuations. A final dividend of 3s. per share makes a total of 6 per cent. for the year, and a bonus of 2 per cent. (both free of tax) is to be paid, leaving £38,345 to be carried forward. Shareholders are to be asked to vote the directors' remuneration free of income-tax. Annual meeting: November 8th.

Cape Electric Tramways, Ltd.

For the year ended June, 1916, the profit was £72,498, and after providing for debenture interest, redemption of debentures, and adding the balance brought forward, the net credit balance is £31,404. The reserve fund has been credited with £5,000, a dividend of 3¾ per cent. on the ordinary shares is to be paid, and £7,983 is to be carried forward. During the year the tramways carried 22,477,366 passengers, earning £212,792, as against 21,680,070 passengers, earning £206,123, in 1914-15. The traffic receipts again show a small improvement, but this is more than set off by the higher cost of operation. This includes increased labour charges and the allowances granted to employés with the Forces. The London expenses have also grown, owing to the excess profits duty and increased income-tax charges. Mr. J. A. Barkley, the general manager at Cape Town, resigned his post in November last owing to ill-health. Mr. W. F. Long, formerly the municipal electrical engineer at Cape Town, entered upon his duties with the company in February last. Shortly after Mr. Long's appointment, labour trouble broke out, which culminated in April in a most unjustifiable strike on the part of a considerable number of motor-men and conductors. This lasted about four weeks, and during the whole of the time, with but few exceptions, the system was kept running full time. Eventually many of the employés who had joined the movement returned to work on the terms laid down by the company, and the strike collapsed. There is every reason to hope that the company's relations with its employés are now established on a satisfactory basis, a result which speaks most highly for the energetic action and tact displayed by Mr. Long and the local directorate in dealing with the situation. Annual meeting: November 15th.

Nairobi Electric Power & Lighting Co., Ltd.

The directors regret delay in the presentation of the accounts for the year 1915 due to war conditions at Nairobi. The table shows the progress of the undertaking:—

	1913.	1914.	1915.
Units generated	723,852	1,020,038	1,122,744
Motors connected, B.H.P. ...	373	422	431
Lights connected (8-C.P.) ...	15,745	24,808	32,176

An auxiliary steam plant was erected at Nairobi and became available for service in May, 1915, since when a second steam plant has also been installed and is now available. These have been paid for partly by the issue of further shares and partly out of revenue. Owing to the late arrival of the steam plant, delayed by war conditions, causing a temporary shortage of supply during the months of January, February, and March, when there was an unprecedented season of drought, an allowance amounting to £969 was made to consumers. It was necessary to send out the consulting engineer to Nairobi to advise what steps should be taken to meet the difficulties of the situation arising out of the enforced postponement of the Thika River installation on account of the war and its effects. This involved a lengthy stay at Nairobi, and expenses connected with this visit, amounting to £850, appear as an unusual item in the revenue account. Stamp duties on the increased capital of the company amounting to £55 are also written off. The net revenue account presents for the first time an item of excess profits duty amounting to £885. As the directors were aware of the unavoidable delay in the dispatch of the yearly accounts from Nairobi, they (as soon as the approximate results were known to them) declared an interim final dividend making altogether 10 per cent. paid for the year on both preference and ordinary shares, less income-tax.

Dick, Kerr & Co., Ltd.

Mr. Claud T. Cayley (chairman) presided, on October 26th, at the Cannon Street Hotel, E.C., over the annual meeting of this company. He said that the year had been a strenuous one for everyone connected with the management of the company. At the last meeting he indicated, as far as he thought advisable, the nature of the work which they were then employed on and expected to be engaged in during the year, but, as the figures of the balance sheet showed, the work actually undertaken by them had been of greater magnitude than the directors then anticipated. Again he was not permitted to give details, but both the manufacturing department and the contracts department were dealing with a larger turnover than ever before, and it was, in his opinion, greatly to the credit of the staff that this should be the case in view of the extent to which it was depleted by many members having joined His Majesty's Forces. Capital expenditure at the works, including goodwill and patents, had been reduced. To those who knew the works this would appear misleading, in view of the material extensions which were in evidence. The explanation, however, was found lower down in the balance sheet in the item "contracts due for works, stock of materials, &c." It was considered, for the purpose of comparison, better to keep separate as far as possible the expenditure in connection with abnormal works, and this had been done by dealing with them as separate and independent contracts. Of course, they would understand that when they returned to normal times there would of necessity be an adjustment between this item and that of "capital expenditure at works." There was no use attempting to make this adjustment at the present time as, under the Munitions Act, the Government would have a very considerable say as to how it should be carried out. The reduction in "capital expenditure, &c., at works" of over £18,000 represented therefore, roughly speaking, the amount written off this item for normal depreciation. It would be noticed that the auditors in their report stated that "No provision has been made for the shrinkage of assets due to the present exceptional circumstances, but the usual charges for depreciation have been made." This was, of course, correct as far as the balance sheet was concerned, but he would draw their attention to certain words in the profit and loss account, namely, "After setting aside reserve for extra depreciation." Everyone who had any experience of manufacturing knew that depreciation of machinery increased with the time it was at work, but not in direct proportion. The more continuously machinery was operated the less time there was to carry out normal repairs; consequently, the life was shortened out of all proportion to the actual amount of time worked, and the directors considered it necessary to provide amply against this exceptional wear and tear. The profit earned for the year, added to £18,346 brought forward, gave them £79,296 available for appropriation. Out of this sum it was proposed to add £25,000 to the special reserve for contingencies, which would bring the total of this reserve up to £50,000. As he indicated last year would be the case, the work on which they were now engaged was abnormal in great part, and a transition period was bound to come during which all their energies would have to be directed to re-establishing normal conditions. It was a matter of sound policy, therefore, to build up a reserve to help them over this transitional period, and this they were doing by means of the reserve he had just mentioned. With regard to the question of war taxation, it was impossible to say much about this matter at present, except that a sum had been reserved in the accounts which the directors considered sufficient to meet any claims which might be made against them. Advantage was taken during the year of an opportunity to acquire a controlling interest in the shares of Messrs. Willans and Robinson. Many of them knew the large amount of business which they had done together, and the pleasant relationship which had always existed, and while it was not proposed to make any alteration in the present directorate and management of Messrs. Willans & Robinson, it would be realised that there was now no obstacle in the way of cementing that relationship by a closer combination of working interests, leading eventually to material benefits for both. It had been a great satisfaction to them all on the board to see the mobile manner in which the members of the staff threw themselves into the work of reorganisation to meet an entirely new class of manufacture, and with no little success under very adverse circumstances. He attributed the success attained, both at their own works and at the new factory mentioned in the report, to the fact that they were able to provide the nucleus from old employés, and in this connection he wished to include not only the members of the staff, but foremen and workmen alike. In these times, when so much was said about slacking and loss of time, it was pleasant to be able to state that the time lost by the workers at their Preston works from all causes, illness included, over a period of 12 months now under review, was under 1.4 per cent. This included men and women, forge and machine shops. As to the future, he was no more inclined to prophesy than he was two years ago, when they met just after the outbreak of war, but he was prepared to say now that with such a staff as their's had proved itself to be, given reasonable protection of

a permanent nature against unfair competition from outside the Empire, there was every reason to look to the future with confidence.

Mr. R. H. Prestwich seconded the motion.

Mr. Lacey complimented the board and Mr. Walter Rutherford, the managing director, on the improved state of affairs, and said he understood the chairman to refer to the control exercised by German financial houses all over the world when he spoke of unfair competition. He did not think at present that they saw any evidence of this matter being dealt with. There was a lot of talk about banking, but he thought they had better leave their banking system alone, for it was the best in the world. He suggested that it was the industrial trust companies who had done them the harm, and these companies seemed to be controlled by the very people who had tried to break down the British Empire.

Replying to questions, the Chairman said the organisation of the company had been carried out and approved by the board as proposed by the managing director. A management committee of six was appointed, and each of these six gentlemen presided over a different department, and was responsible to Mr. Rutherford, whilst Mr. Rutherford was responsible to the board.

The report was adopted, and, on the motion of the Chairman, seconded by Mr. Dickinson, a hearty vote of thanks was passed to the managing director and staff.

Barcelona Traction, Light & Power Co.

The report for the year 1915, as published in the *Financial Times*, states that the company was organised for the purpose of developing hydro-electric power in Spain, with the intention of serving the very large market for light and power, and also developing the electric railway and tramway system in the city of Barcelona and the surrounding district. For the purpose of constructing and operating the hydro-electric works in Spain a subsidiary company, called the Ebro Irrigation & Power Co., Ltd., was formed, and all the capital stock and bonds of the Ebro Co. are owned by the company. For the purpose of developing the electric railway and tramways a Spanish company, entitled the Ferrocarriles de Cataluna, S.A., was also organised, the entire capital stock of which is owned by the company. Owing to developments unforeseen at the time of the original issue of the 5 per cent. first mortgage bonds of the company, the management came to the conclusion that it was desirable to secure control of the chief electric light and power company in the city of Barcelona, known as the Cia. Barcelonesa de Electricidad, as well as of a number of other small light and power companies in the neighbouring towns. Arrangements which provided for the additional money required were made with a group of French and Belgian bankers, but owing to the outbreak of the European war these arrangements could not be carried out, the result being that the construction work under progress in Spain had to be suspended. At the beginning of 1915 a bondholders' committee was constituted with the object of considering the situation, and the recommendations of the committee for reorganising the finances of the company and completing the hydro-electric works were ratified at a meeting of 5 per cent. 50-year first mortgage bondholders in June last. The amount of the 5 per cent. 50-year first mortgage bonds outstanding on December 31st, 1915, was £7,505,000, and the interest on this and on the various securities to that date to be satisfied in 5 per cent. 10-year notes amounted to $3,445,663. The Ebro Co., in addition to operating its own hydro-electric business, operates and controls the electric undertakings of the various subsidiary companies which the company controls through share holdings. The surplus earnings from the undertaking as a whole for 1915, after providing for interest on the prior lien "A" bonds, amounted to £250,669, as against a surplus of £266,750, which it was estimated would have been realised if the works had been restarted at the date contemplated. The board consider the enterprises which the company controls in Spain are developing in a sound and satisfactory manner, and if no unforeseen difficulties arise during the present year the result of the year's working should, notwithstanding the delay and adverse conditions referred to above show a very satisfactory increase over the results of the year 1915. The market for power is a remarkable one and indicates an increasing demand, and in order to meet the growth the distribution system has been, and is being, considerably extended and strengthened, and it is contemplated that a large part of the surplus earnings for the next two years will be applied in carrying out this work. The growth of the business will probably necessitate the extension in the near future of the hydro-electric development, and the board have this matter under consideration, so that when the necessity arises the work can be proceeded with without delay. The following summary of the 1914 and 1915 results from the operation of the combined enterprise shows the progress made:—

	1915. Pesetas.	1914. Pesetas.	Pesetas.
Gross earnings ...	16,804,223.27	15,466,207.91	+ 1,338,015.36
Operating expenses	7,202,839.94	8,381,734.85	− 1,178,894.91
Net earnings ...	9,601,383.33	7,084,473.06	+ 2,516,910.27

The results from operation for the first seven months of 1916 show a considerable increase over the above figures, and are as good as was anticipated in making up the financial programme for the year, notwithstanding a general strike in the textile industry during June and July, which adversely affected the earnings for those months. The whole of the plant, both steam and hydro-electric (with the exception of the turbines at Tremp, which are being reconstructed), is in good working condition.

— Drake and Gorham, Ltd.

The directors report that for the year ended June, 1916, after payment of all charges, including bonuses due to staff, allowances to those who have joined the National Forces, and making provision for contingencies, there remains a net profit of £8,527 (as against £3,817 for 1915), plus £1,623 brought forward, making £10,150 (as against £5,748 last year). A dividend of 4 per cent. (as against 2½ per cent.) requires £5,000; there is put to writing down goodwill £3,000 (as against £1,000), and £2,150 is to be carried forward. The net profits, although below the pre-war average, were more than twice those given in the last balance sheet, and there has been a considerable increase in turnover Contracts in connection with Naval and Military requirements constitute a large portion of the company's operations. A power station of about 4,500 H.P. erected by the company is practically complete, and will shortly be put to work. The wholesale department has further expanded, and shows satisfactory results. The output from the company's works has largely increased, and extensions of this branch are under consideration. The department dealing with electric vehicles propelled by Edison batteries has made good progress. Up to the present 90 men have joined the National Forces, and the difficulty of obtaining necessary labour is increasing. To June 30th £1,733, including directors' fees, had been paid to absentees. Heavy taxation is stated to make it increasingly difficult to finance the extensions which should be made to provide for trade after the war.

Annual meeting: November 9th.

United Electric Tramways Co. of Caracas.

The report for the twelve months ended June 30th states that, after adding the balance forward, the net revenue shows a disposable balance of £14,328, out of which the directors recommend a dividend for the year of 7 per cent., less tax, leaving £2,428 to be carried forward. The profits of the local company were again adversely affected by the war, but during the last months of the year they exhibited a tendency to improve. The internal conditions of Venezuela are satisfactory, and the directors consider that the traffic receipts for the current year are more likely to increase than decrease. The gross receipts amounted to Bs1,426,975, an increase of Bs296 as compared with 1914-15, while the operating expenses were Bs757,806, an increase of Bs24,792, leaving net receipts, at the exchange of 25.25, of £26,501, a decrease of £970. The local company, after providing for the mortgage interest, payable to this company, and setting aside Bs50,000 to reserve and renewal funds, and paying as dividend the whole of the balance of the profits for the year, carry forward the same amount as in the previous twelve months—namely, Bs539,809.—*Financial Times.*

Prospectus.—*Fellows Magneto Co., Ltd.*—With the permission of the Treasury an issue of 50,000 8 per cent. cumulative preferred shares in this company is being offered for subscription. The company is to take over the business of Fellows & Co., magneto manufacturers and repairers, Horseferry Road, Westminster, and Willesden. The company has Government orders in hand valued at £22,443, and the War Office promises a running order of 400 magnetos per month and spare parts, the value of the order being given at about £84,000 per annum. The company is extending the works and machinery to give a greatly increased output. The capital is £75,000 in 50,000 preferred (8 per cent. carrying also 20 per cent. of the net profits thereafter) and 50,000 ordinary shares of 10s. each.

Companies Struck Off the Register.—The following companies have been struck off the register, and they are dissolved:—

Anglo-German Wireless Syndicate.
Atkins Filter, Engineering & Water Softening Co.
Blanchard Lamp Foreign Patents Co.
Bridlington Electrical Engineering Co.
Helis Cell & Accumulator Co.
Improved Railway Signals.
International Filaments.
Lighting & Heating Trust.
New Century Arc Light Co.
New Ignition Syndicate.
Paris Accumulator Co.
Power Transmission Syndicate.
Smoke Consumption (Cowper-Coles Patents).
United Electric Light & Power Supply Co.
Warner Engineering Co.

West India & Panama Telegraph Co., Ltd.—A dividend for the half-year ended June 30th of 6d. per share on the ordinary shares (free of tax) is announced.

Russia.—*The Westinghouse Co.* made a profit of 1,041,488 roubles in 1915, and announces a dividend of 12½ per cent., against 8 per cent. for 1914.

The Moscow Elektroperedatch (Electric Transmission) Co. made a loss of 71,623 roubles in 1915.

The Nezhinsk Electric Co., Nezhin, has been formed; capital 300,000 roubles.

The General Electric Co. made a profit of 2,238,370 roubles in 1915, and pays 10 per cent. dividend, as for the preceding year.

The Russian Electric Co., "Dynamo," made a profit of 1,368,316 roubles in 1915, and pays a 7 per cent. dividend, against 4 per cent. for 1914.

The Petrograd Electric Equipment Co. made a profit of 1,262,388 roubles in 1915, and pays a dividend of 7.3 per cent., against 10.2 per cent. for 1914.

Lisbon Electric Tramways Co., Ltd.—No interim dividend will be paid on the ordinary shares.

West African Telegraph Co., Ltd.—Interim dividend at the rate of 4 per cent. per annum (4s. per share), free of tax.

Westinghouse Brake Co.—Interim dividend of 5 per cent. (10s. per share), less tax, on the ordinary shares.

STOCKS AND SHARES.

TUESDAY EVENING.

THIS week has seen a further diminution in the amount of lighting permitted, and, in the circumstances, it is natural enough to find the market for electricity supply shares leaning to the lower side. The same applies to that for stocks and shares in the gas companies; and if there is anything surprising in the situation at all, it is that the fall should not have been more noticeable. The earlier closing of the shops is another factor which militates against the lighting concerns; and notwithstanding the modification in the hour, from seven o'clock to eight, the restriction is, of course, something of a bear point from the standpoint of the investor in illumination companies.

Markets generally are recovering from the depressing tone set by the news from Roumania last week. Our latest ally seems to be making better progress, and this has set free more money for investment. Next in the financial programme, we shall probably have expectations of a new popular war loan of considerable magnitude, which will furnish the text and the excuse for quietude throughout the Stock Exchange. Business has certainly fallen on restricted lines for the time being, and this notwithstanding the fact that from October to March the Stock Exchange markets ought to be sufficiently active to furnish members of the House with ample employment.

The sentiment in the Home Railway department remains lumpish. The trouble of the matter is that nobody wants to buy Home Railway stocks with the Labour outlook so unsettled and obscure as it is at the present time. Were there any prospect of Labour being satisfied with a definite rate of wages during the war, we might see attention turned to the Home Railway market; but with every settlement liable to be upset within a month or two after its having been fixed, investment money declines to have anything to do with the stocks.

Therefore Metropolitans and Districts are lower, South Westerns have given way, and most of the preferred issues are down. The three Central London assented stocks have all reverted to the same level of 67½. Fresh falls have taken place in the debenture stocks of the District Railway. Underground Electrics maintain their prices well, with the exception of the 6 per cent. income debenture stock, which has fallen two or three points to 102, and the shilling shares, now back to 5s. 6d. The bonds, however, are steady at 89.

Brazil Tractions are amongst the few shares exhibiting strength on the week. Why they should have fallen to 54 was something of a mystery, in the face of the declaration of the usual quarterly dividend of 1 per cent. The recovery to 56 seems to be a natural reaction. Some people point out, however, that for purposes of comparison, the 6 per cent. income debentures of the Underground Electrical Railways are more tempting that Brazil Traction common shares, seeing that the yield on the former is 6⅔ per cent. free of tax—equivalent to 9 per cent. less tax—while that on Brazil Tractions is 7⅛ per cent. In the case of the latter, of course, there is the probability that with any substantial recovery in the Brazilian exchange, Tractions might rise 10 points or more, while the Undergrounds remained stationary.

Brazilian investments, by the way, are generally better, in consequence of the semi-official statement to the effect that Brazil will be able to resume cash payments on her funded debts when the funding scheme expires next July—on which point, perhaps, the cautious observed will do well to keep an open mind.

Mexicans again exhibit a yielding tendency. Once more there is little or no definite news from the country, and in its absence nobody wants to buy. The Latin-Canadian group as a whole is steady, and it is of interest to set out a short table showing to-day's prices as compared with those current at the beginning of the month:—

Common Stock.	Price Oct. 31.	Price Oct. 2.
Canadian General Electric	125	125
Cons. Gas & Electric of Baltimore ...	130	117
Kaministiquia	127½ xd.	128½
Montreal Light, Heat & Power	235 xd.	240
Pennsylvania Water & Power	87	82
Shawinigan Water & Power	139	141½

Most of the business initiated in these shares comes from New York. The rise in Pennsylvanias occurred this week, and is based upon expectations of an increase in the dividend.

The telegraph market is harder, and except for Great Northerns, which have been offered down to 38½, a fall of 30s., what movements have occurred are in the upward direction. The Eastern group is steady, with Eastern Extensions ⅛ better at 13¾. Indo-Europeans gained 12s. 6d. United River Plate Telephones recovered most of the dividend deducted last week. Marconis have receded to 2⅞ on the falling away of business, which induced profit-taking and caused the price to slacken. Reuters are good, the present price of 8½ comparing with 7 at the beginning of the week. It is announced that the directors have received a tentative offer for the whole business of the company on terms which would entitle each shareholder to receive a sum of not less than £10 per share in cash. The circular advises proprietors not to part with their shares at the present time. It is interesting to recall that earlier this year the price of Reuters fell to 4 1/16.

Electric Constructions have risen to their par value of £1, and Telegraph Constructions regained half their loss of last week. On the other hand, Babcock & Wilcox are weaker at 2⅞ ex dividend, and British Aluminium ordinary eased off to 27s. 9d. Except for these changes, the manufacturing list is unaltered, but it continues very firm. In the rubber share market, a better tendency is noticeable, due partly to a rise in the price of the raw material to half-a-crown per lb., and partly to the consideration that the excess profits duty may not have so much effect upon dividends as it was at first feared would be the case. The iron and steel group is somewhat heavy, and there is not much doing in the shares of the copper companies.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Oct. 31, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	10	6⅜	—	£7 11 0
Charing Cross Ordinary	5	5	3⅝	—	7 1 4
do. do. do. 4½ Pref.	4½	4½	3⅞	—	6 6 4
Chelsea	5	4	3	—	6 13 4
City of London	9	8	12¼	—	6 12 0
do. do. 6 per cent. Pref.	6	6	10½	—	5 17 1
County of London	7	7	10½	—	6 10 8
do. 6 per cent. Pref.	6	6	10¼	— ¼	5 18 5
Kensington Ordinary	9	7	6⅜	—	6 4 5
London Electric	4	3	1⅜	—	6 10 5
do. do. 6 per cent. Pref.	6	6	4⅞	—	6 11 4
Metropolitan	8½	8	24	— ⅛	6 0 0
do. 4½ per cent. Pref.	4½	4½	3½	—	7 4 0
St. James' and Pall Mall	10	8	6½	—	6 8 0
South London	5	5	2½	—	6 16 1
South Metropolitan Pref.	7	7	1⅝	—	6 7 8
Westminster Ordinary	9	7	6⅛	—	5 13 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	98	—	6 2 5
do. Def.	80/-	88/6	23½	—	7 10 3
Chile Telephone	8	8	7	—	5 14 5
Cuba Sub. Ord.	5	5	3½	—	6 8 6
Eastern Extension	7	8	13⅜	+ ⅛	*5 16 6
Eastern Tel. Ord.	7	8	14½	—	*5 13 1
Globe Tel. and T. Ord.	6	7	12½	—	*5 12 0
do. Pref.	6	6	10½	—	5 14 3
Great Northern Tel.	22	22	38½	—1½	5 10 0
Indo-European	13	13	51xd	+ ⅝	6 7 8
Marconi	10	10	2⅞	— ⅛	3 9 8
New York Tel. 4½	4½	4½	100	—	4 10 0
Oriental Telephone Ord.	10	10	2⅜	—	4 6 6
United R. Plate Tel.	8	8	6½xd	+ ⅛	*5 18 5
West India and Pan.	1	—	1	—	—
Western Telegraph	7	8	14½	—	*5 10 4
HOME RAILS.					
Central London, Ord. Assented	4	4	67½	— ½	5 18 8
Metropolitan	1½	1	29½	— ½	4 9 0
do. District	Nil	Nil	16	— ⅛	Nil
Underground Electric Ordinary	Nil	Nil	1⅛	-	Nil
do. do. "A"	Nil	Nil	5/6	—6d.	Nil
do. do. Income	6	6	89	—	*6 14 7
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4⅛	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	3½	—	8 9 2
do. 2nd Pref.	5½	5½	2⅜	—	—
do. 5 Deb.	5	5	70	—	7 2 10
Brazil Tractions	4	4	56	+1	7 2 10
Bombay Electric Pref.	6	6	10½	—	5 17 3
British Columbia Elec. Ry. Pfce.	5	5	72	—	6 19 0
do. do. Preferred	—	Nil	55	—1	Nil
do. do. Deferred	—	Nil	14	—1	Nil
do. do. Deb.	4½	4½	66½		6 7 10
Mexico Trams 5 per cent. Bonds	—	Nil	40	—	Nil
do. 6 per cent. Bonds	—	Nil	83½	—	Nil
Mexican Light Common	Nil	Nil	17	—	Nil
do. Pref.	Nil	Nil	30	- 1	Nil
do. 1st Bonds	Nil	Nil	40	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	14	15	2⅞xd	— ⅛	5 4 4
British Aluminium Ord.	5	7	27/9	- 9d.	5 15 4
British Insulated Ord.	15	17½	19½	—	7 0 0
British Westinghouse Pref.	7½	7½	2½	—	6 0 0
Callenders	15	20	12½xd	—	8 0 0
do. 5 Pref.	5	5	4½	—	5 17 8
Castner-Kellner	20	—	8⅜	—	5 6 8
Edison & Swan, £3 paid	Nil	—	10/-	—	Nil
do. do. fully paid	Nil	—	1⅜	—	Nil
do. do. 4 per cent. Deb.	5	5	62½	—	8 0 0
Electric Construction	6	7½	1	+ 1/16	7 10 0
Gen. Elec. Pref.	6	6	10	—	6 0 0
do. Ord.	10	10	14½	—	6 18 0
Henley	20	25	17½	—	7 13 10
do. 4½ Pref.	4½	4½	4½	—	5 6 0
India-Rubber	10	10	12	—	*3 3 4
Telegraph Con.	20	20	88½	+	*5 4 7

* Dividends paid free of income-tax.

THE USE OF IONISED AIR IN AGRICULTURE.*

By INGVAR JORGENSEN.

(*Concluded from page* 454.)

The current density in the discharge as obtained with the Lodge-Newman system described in the beginning of this article was found to vary between 10^{-14} and 10^{-11} amperes per sq. cm.

It will be readily understood that the ions moving down towards earth will be influenced by two forces, a vertical force caused by the potential gradient and a horizontal force due to the wind; the consequence is that part of the ions are carried outside the area covered by the wires, and the effect of the discharge is thus not limited to the area under the wires; this dispersion is, of course, very marked in the Lodge-Newman system when the wires are 15 to 16 ft. from the ground.

Details of the distribution of the discharge were given in a paper† by Prof. Priestley and the writer in 1914. As regards the meteorological factors, it can be stated that any metereological process which will decrease the mobility of the ions, *i.e.*, increase the number of molecules, will decrease the current density of the discharge. Particularly condensation processes have an important effect, as will be seen from fig. 4, which records the potential gradient

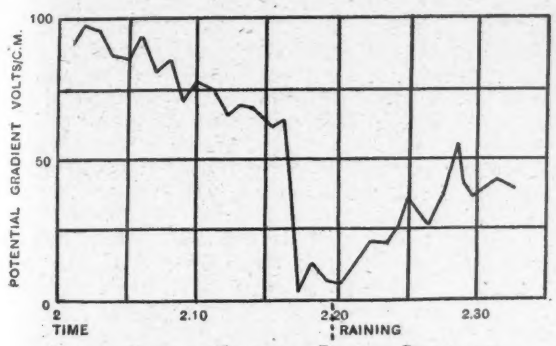


Fig. 4.—Showing Effect of Rain on Discharge.

during the change from fine weather to rain. It will also be seen that is possible to maintain an appreciable discharge during rain.

The influence of meteorological factors can be summarised then by saying that the current density of the discharge decreases with increasing wind velocity and with decreasing mobility of the ions.

It should also be observed that many atmospheric impurities will move under the influence of the potential gradient under the wires. This, in industrial districts, will lead to the precipitation of many harmful substances on plants. Also radio-active disintegration products possessing a charge will, in many cases, be precipitated, and cause considerable difficulty and error in the measurements.

In regard to the disturbances caused by the abnormal conditions of atmospheric electricity in industrial districts, reference must be made to a paper by Mr. Steuart and the writer.‡

The difficulties met with in attempting to confine the discharge to the area under the wires necessitated the performance of a number of experiments, in which the experimental area was separated from the control by vertical screens of wire netting connected to earth. The smallest mesh obtainable commercially is, however, ½ in., and even this is rather expensive for large scale experiments.

It is necessary that the screen should extend to a height several feet above the level of the discharge netting.

The amount of ionised air carried outside the experimental area can thus be considerably reduced, but not to zero. Even enclosing the area in a wire cage does not stop the ionised air completely; in one case an experiment was carried out by Miss E. C. Dudgeon with a crop of potatoes growing in such a cage 100 yds. from an electrified area; measurements showed, however, that, with the wind in the proper direction, as many as 10^5 ions per cb. metre were found in the cage (the air under the discharge netting contained about 10^9).

The cage is shown in fig. 5. It must be emphasised that such a cage also alters a good many other conditions, particularly as regards light and humidity.

Fig. 5.—Showing Cage of Wire Netting (½-in. Mesh) covering an Area of $\frac{1}{10}$th of an Acre.

The writer is indebted to Mr. William Low, of Balmakwan, Montrose, for opportunities of taking part in some experiments with a large wire screen insulated from earth. By charging this screen to a suitable potential of the opposite sign to that of the discharge netting, it seems possible to obtain an effective screen.

In the later experiments by Miss Dudgeon, at Lincluden, Dumfries, the distance of the discharge netting from the ground has been considerably reduced. In 1915, the distance was 12 ft.; in 1916, about 7 ft.; and in the latter case, the amount of ionised air carried outside the area was very small. At the same time, a stronger discharge is obtained, and the spreading of the discharge diminished.

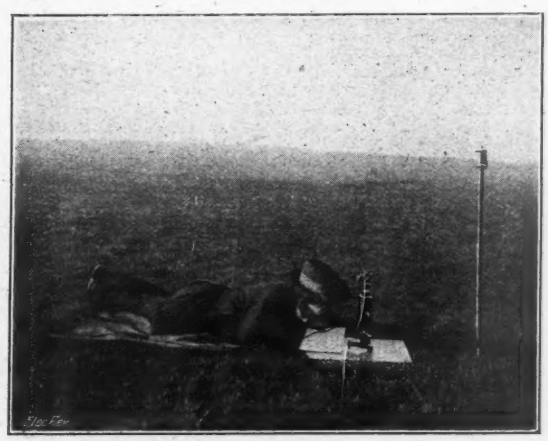


Fig. 6.—Measurement of Potential Gradient.
Flame collector on ebonite rod connected to Exner electrometer.

The writer would like to draw attention to a simple and convenient method for investigating the distribution of the discharge, which will also give comparative measurements of the strength of the discharge. The apparatus is shown in fig. 6, and consists of a flame collector on an ebonite

* The information contained in this article is derived from experiments carried out by the writer in Copenhagen (at the Government Agricultural Experimental Station) and in this country under the Board of Agriculture, in conjunction, first, with Prof. J. H. Priestley (University of Leeds), and, later, with Prof. V. H. Blackman (Imperial College of Science and Technology).

† I. Jorgensen and J. H. Priestley: *Journal of Agricultural Science*, Vol. VI, Part 3.

‡ D. W. Steuart and I. Jorgensen: Notes on the Atmospheric Electrical Potential Gradient in the Industrial Districts Around Leeds. *Proc. Roy. Soc., Edinburgh*, 1914.

rod and an aluminium leaf electrometer (the so-called Exner type).

The collector is used in order to obtain the potential of the air at the height of the flame. (It is well known that flames bring about ionisation of the air, and any other substance—*e.g.*, a radioactive substance—which will impart conductivity to the air can be used.) The candle is pressed by a spring against the collar of a metal tube, and thus kept continually burning at the same level. This metal tube is surrounded by a glass chimney, and a wire gauze cage affords protection against the wind. The metal frame of the collector assumes the potential of the air just above the frame, and if connected to the electrometer

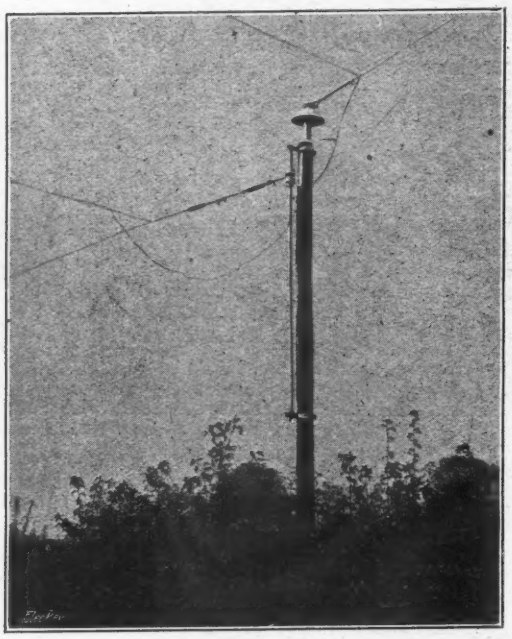


Fig. 7.—Showing Arrangement for Alteration of the Height of the Discharge Network on the Left.
A reel can slide up and down the iron rod attached to the pole.

this potential can be determined. The deflection of the electrometer leaves is a measure of the potential, to which the electrometer is charged, but the rate at which the leaves are deflected can be used as a measure of current (this is a method much employed in radioactivity measurements).

If a current of i amperes charges the electrometer of capacity c in t seconds to v volts, then the current may be determined from the equation—

$$i = c/(9 \times 10^{11}) \cdot v/t.$$

In practice it was generally arranged that the leaves deflected until they touched the sides of the earth-connected electrometer cage. They would then lose their charge, and return to the zero position. The number of times the electrometer thus discharged per minute would thus give a rough measure of the strength of the discharge. This method has been used by Miss Dudgeon with much success in her experiments.

In the foregoing I have indicated some of the technical problems involved in the method, but the practical engineer will, no doubt, ask whether the results obtained are of sufficient economic importance to justify the expenditure of money on technical research? and what, at present, is the balance between the cost of electrical energy supplied and the increase in crop production?

The first question is extremely difficult to answer. Agriculture is an old industry, but its methods have not changed a great deal through the ages. Indeed, things have altered probably less in agriculture than, for instance, in the building and shipwright's trades, in which the permanence through the ages of the fundamental principles has been emphasised by Kipling.*

Thus up to the present day the efforts of agriculture have been limited to attempts to control the factors which operate through the soil. But it must not be forgotten that plant growth is dependent both on material and on the radiant energy of the sun, and a large part of the material is obtained from the air (carbon dioxide).† No attempt has been made to increase either the gaseous compound nor the radiant energy, although there can be no doubt that in many cases a lack of carbon dioxide or of radiant energy limits the growth of crops. The methods dealt with in the present article form an attempt to supply energy artificially, thus constituting a new departure which deserves attention, and so the possibilites and limitations of the method should be fully investigated.

Certainly results obtained so far seem to indicate great possibilities; but they must be accepted with a certain amount of reserve, remembering that technique in agricultural experiments is far from perfect.

For accounts of earlier work, the reader is referred to Lemström's book, where many cases of remarkable results are recorded. It may also be interesting to quote some of the figures given by Sir Oliver Lodge in the paper already referred to. Experiments with wheat were carried out at Mr. Bomford's farm at Bevington, which showed in 1906 increases of 39 per cent. and 29 per cent.; in 1907, an increase of 29 per cent.; in 1908, 24·3 per cent.; in 1909, 23 per cent.; in 1910, 22 per cent.; in 1911 (drought), 0 per cent.; and in 1912, an increase of 20 per cent.

It is mainly due to the energy and enterprise of Miss E. C. Dudgeon, of Lincluden House, Dumfries, that the experiments are being continued in this country, and it has become possible to start a scientific investigation of the problem with the support of the Board of Agriculture.‡ The writer records with pleasure his indebtedness to Miss Dudgeon for her collaboration in pioneer work in this subject.

In the crop experiments with oats, carried out by Miss Dudgeon in 1915, the following increases were obtained‖ :—

Grain	...	...	...	30 per cent.
Straw	...	...	...	58 per cent.

Still better results were obtained in 1916.

It will, of course, be understandable that if such results are obtainable under all circumstances, particularly if the present high prices of cereals in this country should continue, it would pay to employ the method on a very large scale. The actual current used at present is small; thus in Miss Dudgeon's experiments this year 3 amperes at 50 volts were used in about 800 hours. If this current had been available from a power station the actual expense would have been negligible, compared with the increased value of the crop.

However, the area employed by Miss Dudgeon in the Lincluden experiments was only about one acre. The power consumed in the primary of the induction coil (about 150 watts) was badly utilised, as only 10—20 watts were discharged from the overhead network.

Thus we are again reminded of the fact that the network is a very essential part of the installation (as important as the antenna in a wireless station). Upon the construction of the network depends the efficiency of the installation. It will be seen that with the same energy used in the primary of the induction coil, a much larger area could be provided with ionised air. The writer has not had an

* R. Kipling: "Rewards and Fairies," London, 1910, page 55. For instance, Pharaoh the Great, addressing the bricklayer engaged on building flats near the Marble Arch, says:—

"Your glazing is new and your plumbing's strange,
But otherwise I perceive no change,
And in less than a month if you do as I bid,
I'd learn you to build me a Pyramid."

† For a general account of this subject, see the articles by I. Jorgensen and W. Stiles on Carbon Assimilation in the "New Phytologist," 1915-16.

‡ This is at present being carried out at the Imperial College of Science and Technology under the general direction of Prof. V. H. Blackman.

‖ For details see *Journal of the Board of Agriculture*, October, 1916.

opportunity of taking measurements in an installation where the network covered more than 12,000 sq. metres; but in all cases the discharge has been proportional to the area covered by the network, the current used in the primary of the induction coil being approximately constant. Presumably this was not appreciated by Dr. Breslauer (the German agent of the Agricultural Electric Discharge Co.*), who measured the current passing into a network covering 30,000 sq. metres and one covering 60,000 sq. metres. In the first case, a current of 0·38 milliampere was obtained (at 60,000 volts), and in the second case, 0·51 milliampere. It is difficult to see why he should assume that the difference between these two measurements (0·13 milliampere) should be the true value of the discharge current in the network covering the area of 30,000 sq. metres.

A disadvantage of the Lodge-Newman system is that the Lodge valve will not stand a strong current; for the same reason it has not found very extensive application in X-ray work.

It might, perhaps, interest readers of this journal to have an estimate of the cost of an installation similar to the Lodge-Newman; the figures are, of course, only approximate, and are not those of the Agricultural Electric Discharge Co.:—One induction coil, £30 to £40; one mercury break, £10; and five Lodge valves, £10.

The cost of the wires in the network is quite negligible; special high-tension insulators are not required unless the discharge is wanted during rain and in damp air; it is sufficient to use ebonite rods between the netting and the pole.

Thus neither the installation nor the cost of operation should prevent its application on a large scale, if future experiments confirm the experiences gained so far, and it will be seen that in this case an entirely new field is opened for electrical engineering.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Western Local Section.

On Monday, last week, Prof. D. Robertson, as chairman, delivered his inaugural address, of which the following is an abstract:—

A century ago the inventive genius, of itself, had a fairly free scope, but in the industrial world of the present day it must be coupled with a much higher degree of scientific knowledge and technical training, and have behind it much greater material resources than formerly, if it is to make its influence felt. In the early days of industry the problems to be solved were mainly mechanical, speeds were low, the choice of materials was comparatively small, and the duties put upon them were moderate, while prices were high enough to permit the use of sufficient material to give a good big factor of safety. Only the simplest calculations had to be made, and little scientific knowledge was necessary beyond that acquired in the daily routine of the shops. Consequently, many important advances were made by men having but the slightest theoretical knowledge.

Nowadays, competition required the utmost to be got out of each ounce of material; higher speeds may cause extra material to be a source of weakness rather than of strength, and introduce phenomena whose control requires the keenest tools that theory can supply. The advent of electrical transmission has brought into being an entirely new branch of engineering, ever extending its bounds, involving enormously more theoretical knowledge than the older branches, and requiring, in addition, a clearer insight into abstract things. On all hands, calculations must be more exact, and side issues of little importance in the old days have now to be closely taken into account.

We have every reason to be proud of the advances made, and being made, by our own countrymen in the domain of science, but at the same time I do not think we put into this work a sufficient number of men of the right sort, the right training, and the right temperament. Further, I do not believe we shall ever get them until we offer them prospects comparable with those open to the other learned professions. It is not sufficient to depend alone on the favoured few whose circumstances enable them to pursue their own ideas without having to worry about the cost or about their bread and butter. To keep up the prosperity of our country we must put the best brains from all classes to those tasks which are most likely to increase the common good.

Although legislation can help but little in raising science to its rightful status, still it can do something. It might, for instance, encourage the study of science in our public schools by insisting on a certain minimum of scientific knowledge in future generations of public officials. Another thing which the Government could do is to make the value and number of the scholarships open to the science boy somewhere about level with those given for classical studies.

By thus making the way to a large number of the lucrative positions lie through a study of science, we should very quickly find every school running a real scientific side, and our universities would then be able to pass away from the condition of having to make their scientific alumni pass their first year in learning elementary work which they ought to have had at school.

But we must mainly look to our own men of eminence to bring about a better state of things by continually keeping the needs of science before the proper influential quarters. The war has focused attention on scientific work with an entirely new force. Never again must public opinion be allowed to forget how much is owed to the often-time obscure worker in the research laboratory. In particular, our leading men must see that their magnificent rally to the assistance of a Government, whose "neglect of science" has been their perpetual lament, shall not be misconstrued by the politician and official, and confirm their notion that scientific men are merely theorists whose ideas can usually be neglected, and who are too ætherial to require any encouragement or any visible means of support, but whose assistance can always be obtained, on those rare occasions when it is useful, without any reward and, indeed, almost without the trouble of having to ask for it. In short, our best men must make the Government appreciate the value of their services, and the only way to do that is to see that they are paid for.

The true research worker must possess an infinite patience, a fertile imagination, a wide knowledge of the laws of nature, and an unbounded faith in the possibility of accomplishing the task on which he is engaged. He must refuse to be diverted from his goal by any reputed impossibility, and, if necessary, he must be prepared to overthrow accepted ideas when they stand in his way. The advances of the genius are made by accomplishing the impossibilities of his fellows. In 1900, Bremer improved the arc light by doing exactly what everyone would have said was the wrong thing; before Marconi's experiments, in 1901, it was perfectly easy to demonstrate that trans-Atlantic radio-telegraphy must for ever be impossible; in 1910 Coolidge succeeded in drawing tungsten into the finest wires that were ever made, in spite of the knowledge among the experts that this metal was far too brittle to be even formed into a rod; in 1913 Langmuir produced the gas-filled lamp, when we all knew perfectly well that the best possible vacuum was absolutely necessary for an efficient lamp.

And so it will always be. He is not worthy of the name of pioneer who regards even the laws of gravitation, and of the conservation of energy, mass and momentum as dogmas which may not be attacked and overthrown when they block his way.

Research is best dealt with in bulk, so that workers in different fields may come into daily intimate contact. A man with a new idea will develop it more rapidly and carry it further if he discusses it over a pipe with a fellow spirit, even though the latter can do no more than listen to the exposition. If the subject borders on his own in any way, the cross-fertilisation of the sciences produced by such a discussion may lead to enormous results. But the research worker must also come into close touch with the industrial side of his own subject. The man in the factory meets many problems for whose solution he possesses neither the time nor the knowledge. The scientific man, however willing and competent he may be, would never meet these problems by himself. Keep these two men apart and the problem remains for ever unsolved, but bring their experiences together and progress is sure to follow.

For the success of this co-operation, mutual respect and confidence are required between the manufacturing and scientific sides of industry. This co-operation has been greatly developed with marvellous results in several directions in America, where its realisation has been facilitated by the aggregation of capital into huge trusts. To some extent the difficulty can be overcome by insisting that the research workers should periodically spend some time in the factory.

Each industry has its own problems which are more or less recognised by those engaged in it. I wish to direct your attention to one rather big problem of the utmost importance for the future welfare of our own country. I refer to our supply of energy. Past ages have placed vast stores to our credit in the great coal bank, but as we are drawing our cheques upon it with ever-increasing prodigality, and nothing is now being paid into it, sooner or later we shall find our cheques returned marked "no funds." It will not likely occur in our time, but, historically speaking, the exhaustion of our coal supplies is not remote. It seems fairly certain to come within three centuries, and may even occur within one. If our country is not to decline into a very inferior position by that time, we must, in the interval, either discover new sources upon which we can draw, or else we must contrive to live within our income.

* M. Breslauer: "Zeitschrift für Elektrochemie," 1910, p. 357.

Our annual consumption of coal is about 200 million tons per annum. Since the energy of one ton of coal is almost exactly 1 KW.-year, we are drawing on our energy capital at the rate of about 200 million KW.

We have, of course, other sources of energy of which we are aware, and possibly many others still unknown. The energy of disintegration of the atoms is enormous; when this is brought under our control we shall have an ample supply for a few ages more, and may even be able to ward off the approach of the next ice age, which is due in some thousands of years.

Another large store of energy, mainly derived from the kinetic energy of rotation of the earth, is made available to us through the tides. To raise the level of one square mile of sea by one foot involves the expenditure of about 340 KW.-hours. Under ideal conditions of admitting all the water at high tide, and releasing it again at low tide, this amount of energy would be available each half-tide of, say, 6¼ hours. The tidal power is thus equivalent to about 55 KW. per square mile per (foot rise)^2. Ideal conditions could not be realised, and there would be losses in the turbines, and so we probably err on the high side if we take 10 KW. per square mile per (foot rise)^2 as the maximum we might expect to be able to utilise. This would give 10,000 KW. per square mile with a double tidal amplitude of 31.5 ft., and 500 KW. for one of 7 ft.

The Bristol Channel is by far the most favourable place in this country for the large scale utilisation of the tides, and I think the Firth of Clyde stands next because of the large area which could be enclosed within a comparatively short dam. We shall not be far out if we take the 10,000 KW. per square mile as applicable to the first, and the 500 KW. to the second of these areas.

A dam across the Bristol Channel from Brean Down to Lavernock Point, taking the Flat Holm on the way, would be under eight miles long. It would enclose well over 100 square miles of water, and would give, say, a million KW. One built across below Ilfracombe would be nearly 30 miles long, would enclose quite 10 times as much, and might be expected to give us about 10 million KW.

The only possible place for a dam across the Firth of Clyde is the shallow bar somewhere about the Girvan-Kintyre line. It would be in somewhat deeper water than the Bristol Channel ones, would be just over 30 miles long, and would enclose much about the same area as the lower Channel one. But, owing to the much smaller tides, it would probably give us no more than half a million KW.

We have other estuaries which could all be made to contribute their quota, but when all are harnessed I think we shall still be very far short of the equivalent of our present consumption of coal. The tides will never do more than replace a quite small part of our coal consumption.

The intensity of the sun's radiation as it falls on the earth's atmosphere is somewhere about five million KW. per square mile of normal surface, which would mean about three million KW. per square mile of land at our latitudes at the equinox noon. Averaging it out throughout the 24 hours and throughout the year we may call it one million KW. per square mile here. Over one-half of this is absorbed by the atmosphere, but what is left is ample for our needs, and we must find a method of turning it to our own ends before our coal supply is exhausted.

For the economical utilisation of the sun's energy on a large scale it will be necessary to keep the size of the power-house within reasonable dimensions, and to provide for keeping it running throughout the whole 24 hours. The direct application of the rays for driving a heat engine, which has actually been done at Meadi, in Egypt, would thus scarcely meet our needs, even if our climate were suitable, which it is not.

Storage of the energy in some intermediate form is thus necessary to enable us to concentrate it and to level up the discrepancies between the curves of supply and demand. Nature provides us with such storage in several forms. First we have gravitational energy in the shape of water raised from the oceans up into the clouds, and this has the especial merit that it makes some use of the areas covered by water. But the smallness of our island makes our share of this bountiful supply somewhat meagre. Other countries are more favoured in this respect than ours, and every development of the electrical transmission and utilisation of power increases the advantages which their industries consequently possess over ours.

The winds give another means of temporarily storing the energy received from the sun, partly in the kinetic form and partly in the compression of the air. Here, again, difficulties arise from the uncertainties of the winds, and from the enormous size which a large-power windmill would have. Still, research must not dismiss anything as impossible. The rapid advances in the size of steam and water turbines and of electric generators should teach us not to dismiss wind-power as utterly hopeless.

The last form of storage which I shall consider is chemical energy, to which class, indeed, our coal itself belongs. The only way in which the solar energy is taken up chemically in nature, so far as I am aware, is through the agency of plant life. Failing other means, *we must grow our fuel.* I therefore offer to our agriculturists the problem of producing a plant having a high calorific value, which shall utilise as high a proportion as possible of the energy falling on the areas devoted to its cultivation, and which shall be suitable for use as fuel, either directly or by distilling alcohol or other spirit from it.

At the same time I ask our electrochemists to find a method of taking up that energy electrically from the plant, or its products, without first converting it into heat, so as to avoid the large thermo-dynamic losses inherent in the heat engine.

Or, better still, I ask our chemists to devise some reaction which will occur with the absorption of energy under the action of sunlight, and which can be reversed, under control, with the return of that energy in the electrical form. In short, give us a storage battery which is charged by submitting the active materials to sunlight, and which is discharged in the ordinary way.

As a last resource, in case these should fail, let our ultra-physicists combine with the biologists and produce between them a sufficient number of Maxwell's sorting demons to emancipate us from the second law of thermodynamics.

DIESEL ENGINE USERS' ASSOCIATION.

The first of the autumn meetings of the Diesel Engine Users' Association was held on October 20th. After the election as members of the association of several engineers having the control of Diesel engine plant, certain resolutions were passed providing for alterations and additions to the rules. From the end of the current year an entrance fee of one guinea is to be charged to all new members elected.

To meet the demand which has arisen in many quarters for copies of the reports of proceedings and of the general information and data circulated by the Association, provision has been made for a class of "subscribers." Such "subscribers," who must be duly accepted by the committee, would consist of individuals or firms who are not qualified for full membership, and who would be entitled to receive the particulars circulated on payment of a sum of one guinea per annum. They would not be entitled to attend the meetings of the Association (except by special invitation of the committee), neither would they have any voice in the control of the Association. "Subscribers" may at any time send communications to the honorary secretary, and, if in the opinion of the committee they are of sufficient general interest, such communications may be read and discussed at a meeting of the Association.

Air Compressor Explosions and Troubles.—The committee presented a report on the subject of explosions in air compressors and on the various troubles experienced with air compressors, having special reference to the accident which occurred at the generating station of the Smithfield Markets Electric Supply Co., Ltd., in February last. After discussion on certain points this report was adopted by the Association, and it is in due course to be printed and circulated among the members.

Tar Oils as Fuel for Diesel Engines.—Mr. Napier Prentice gave further information in connection with the application which had been made by the Suffolk Electricity Supply Co., Ltd., for the avoidance or suspension for the duration of the war of the Konrad Aust patent in connection with the use of tar oils as fuel in Diesel engines. He considered that on national grounds such action should have been urged or supported by a Government department. Since the application had been made, however, his experience in the use of tar oils in Diesel engines without the fitting of any pilot ignition apparatus had been so satisfactory that he did not think it would be advisable that his company should incur any costs in connection with the adoption of the method of working covered by the patent. He was now effecting a saving of about 50 per cent. in fuel costs by the partial use of tar oil.

Mr. Geoffrey Porter (president) gave particulars concerning a pilot ignition apparatus which had been fitted to a Diesel engine at Worthing. The saving in fuel costs obtained by using tar oil in this manner with about 10 per cent. of crude oil for the ignition charge amounted, up to date, to about 47 per cent. The only trouble experienced had been in connection with the formation of a deposit which choked the pulverisers. No trouble had been experienced with the exhaust valves or with the needle valves. He also stated that he had tried on another engine a mixture of three parts of tar oil to one of crude oil. The engine had knocked rather heavily, but at three-quarters of full load, and with fairly continuous running, no further troubles had been experienced. He, however, did not favour the use of mixtures of tar oil and crude oil. There was some risk of misfiring, and there was a difficulty in securing complete mixture of the two classes of fuel oil.

Mr. W. A. Turnbull stated that he had worked a Diesel engine on tar oil with a slight alteration to the flame-plates, and he had obtained a saving of about 50 per cent. in fuel costs. He had not noticed any corrosive effect by the tar oil on the copper pipes or brass fittings.

Further information on the subject of actual experience in the use of tar oils was given by Messrs. F. W. Strickland, J. Broadhurst, and W. Fennell.

Mr. Napier Prentice strongly urged that on national grounds, as well as in their own interests, Diesel engine users should continue to endeavour to make use of home products of fuel oil to the greatest possible extent in preference to fuel oil imported from abroad.

TRADE STATISTICS OF THE STRAITS SETTLEMENTS.

The following statements, showing the imports (not for transhipment) of electrical and other materials into the various Straits Settlement ports in 1915, is taken from the recently-issued official trade statistics. In compiling these statistics the first port of shipment is generally accepted as denoting the country of production. The values for 1914 are added for purposes of comparison, with notes of any increases or decreases.

IMPORTS INTO SINGAPORE.

	1914. Dollars.	1915. Dollars.	Inc. or dec. Dollars.
Telegraph and telephone materials.—			
From United Kingdom ...	145,000	389,000	+ 244,000
,, Belgium	3,000	—	– 3,000
,, Germany	1,000	—	– 1,000
,, Other countries ...	10,000	16,000*	+ 6,000
Total	159,000	405,000	+ 246,000
* Australia $2,000.			
Tramway and railway materials.—			
From Belgium	65,000	—	– 65,000
,, Germany	6,000	—	– 6,000
,, United Kingdom ...	200,000	77,000	– 123,000
,, Other countries ...	6,000	178,000*	+ 172,000
Total	277,000	255,000	– 22,000
* United States $165,000.			
Electrical machinery.—			
From United Kingdom ...	209,000	219,000	+ 10,000
,, Germany	17,000	2,000	– 15,000
,, Italy	6,000	5,000	– 1,000
,, Sweden	3,000	—	– 3,000
,, Belgium	1,000	—	– 1,000
,, United States ...	8,000	13,000	+ 5,000
,, Japan	2,000	8,000	+ 6,000
,, Other countries ...	17,000	40,000*	+ 23,000
Total	263,000	287,000	+ 24,000
* Netherlands $17,000.			
Engines, boilers, and parts.—			
From United Kingdom ...	325,000	266,000	– 59,000
,, Germany	3,000	—	– 3,000
,, United States ...	—	8,000	+ 8,000
,, Other countries ...	14,000	27,000*	+ 13,000
Total	342,000	301,000	– 41,000
* Denmark $5,000.			
Machinery, other (except sewing machines).—			
From United Kingdom ...	671,000	502,000	– 169,000
,, Australia	4,000	36,000	+ 32,000
,, Belgium	15,000	—	– 15,000
,, Germany	33,000	—	– 33,000
,, Holland	2,000	—	– 2,000
,, United States ...	60,000	65,000	+ 5,000
,, Other countries ...	125,000*	116,000	– 9,000
Total	910,000	719,000	– 191,000
* Selangor $55,000.			
Lamps and lampware.—			
From Belgium	8,000	—	– 8,000
,, Austria	6,000	—	– 6,000
,, Germany	125,000	17,000	– 108,000
,, United Kingdom ...	76,000	45,000	– 31,000
,, United States ...	9,000	6,000	– 3,000
,, Japan	4,000	15,000	+ 11,000
,, Other countries ...	15,000	33,000*	+ 18,000
Total	243,000	116,000	– 127,000
* Holland $18,000.			

IMPORTS INTO PENANG.

	1914. Dollars.	1915. Dollars.	Inc. or dec. Dollars.
Electrical machinery.—			
From United Kingdom ...	128,000	44,000	– 84,000
,, Germany	20,000	—	– 20,000
,, Denmark	5,000	2,000	– 3,000
,, Other countries ...	20,000*	6,000	– 14,000
Total	173,000	52,000	– 121,000
* Holland $7,000, and United States $9,000.			
Machinery, other (except sewing machines).—			
From United Kingdom ...	183,000	88,000	– 95,000
,, Belgium	3,000	—	– 3,000
,, Germany	10,000	—	– 10,000
,, United States ...	16,000	18,000	+ 2,000
,, Other countries ...	18,000	8,000	– 10,000
Total	230,000	114,000	– 116,000
Engines, boilers, and parts.—			
From United Kingdom ...	328,000	163,000	– 165,000
,, Australia	60,000	33,000	– 27,000
,, Germany	5,000	—	– 5,000
,, Belgium	2,000	—	– 2,000
,, United States ...	16,000	—	– 16,000
,, Netherlands ...	39,000	5,000	– 34,000
,, Other countries ...	8,000	4,000	– 4,000
Total	458,000	205,000	– 253,000
Lamps and lampware.—			
From Belgium	2,000	—	– 2,000
,, Germany	27,000	2,000	– 25,000
,, United Kingdom ...	36,000	28,000	– 8,000
,, Other countries ...	6,000	11,000*	+ 5,000
Total	71,000	41,000	– 30,000
* Japan $5,000.			
Telegraph and telephone materials.—			
From United Kingdom ...	1,000	—	– 1,000
Tramway and railway materials.—			
From United Kingdom ...	13,000	2,000	– 11,000
,, Belgium	8,000	—	– 8,000
,, Holland	—	1,000	+ 1,000
Total	21,000	3,000	– 18,000

IMPORTS INTO MALACCA.

	1914. Dollars.	1915. Dollars.	Inc. or dec. Dollars.
Telegraph and telephone materials.—			
From United Kingdom ...	12,000	2,000	– 10,000
Engines, boilers, and parts.—			
From United Kingdom ...	—	5,000	+ 5,000
Electrical machinery.—			
From United Kingdom ...	—	1,000	+ 1,000
Machinery, other (except sewing machines).—			
From United Kingdom ...	37,000	18,000	– 19,000
,, Other countries ...	10,000	11,000*	+ 1,000
Total	47,000	29,000	– 18,000
* Federated Malay States $10,000.			
Tramway and railway materials.—			
From United Kingdom ...	3,000	—	– 3,000

N.B.—Dollar = 2s. 4d.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

BRITISH DOMINIONS AND POSSESSIONS.—A Supplement (Part I) to the *Board of Trade Journal* of October 12th contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported to various destinations from British India, Canada, New Zealand, South Africa, Newfoundland, Egypt, Malta, Cyprus, Mauritius, and Ceylon. A further Supplement (Part II), issued on October 26th, contains similar lists for the Straits Settlements, Hong-Kong, Nigeria, Gold Coast, Jamaica, Barbados, Trinidad and Tobago, and British Guiana. The information given in these two Supplements supersedes that given in the Supplement published on July 13th last. Copies of the Supplements may be obtained, price 3d. each (post free 3½d.), from Messrs. Wyman & Sons, Fetter Lane, E.C.

UNION OF SOUTH AFRICA.—Instructions have recently been issued by the Union Customs Authorities in regard to the invoices of goods for importation into the Union, and the necessity of clearly distinguishing thereon the home consumption prices from the export prices of the goods.

Under Section 7 of Act 26 of 1914, the value of goods subject to *ad valorem* duty in the Union shall be taken to be the "true current value" for home consumption in the open market of similar goods in the principal markets of the country from which, and at the time at which, the goods were imported, including carriage to the port of shipment and the cost of packing and packages, but not including agent's commission when such commission does not exceed 5 per cent.; provided that in no case shall the value for purposes of duty, as above defined, be less than the cost of the goods to the importer at the port of shipment.

The Commissioner of Customs has pointed out that a fruitful source of trouble in connection with the invoices is the practice of many suppliers invoicing goods at c.i.f. or f.o.b. prices, and making a declaration that these prices are the home consumption prices, and then adding a further statement at the foot of the invoice that these prices include certain charges as detailed, for packing, railage, freight, &c. Such a declaration is obviously wrong.

In order to conform to the requirements of the Customs

Authorities, H.M. Trade Commissioner in South Africa suggests that firms should reserve one part of their invoice forms for the ordinary "true invoice," and supplement this by a statement that the subjoined statement of values and costs is accurately given in conformity with the requirements of the Union Customs Tariff:—

1. Home market value	£ : : :
Less home trade discounts	: : :
Net value	: : :
Packing	: : :
Railage	: : :
Shipping charges	: : :
Total	£ : : :

2. Actual cost of goods at port of shipment to importer in South Africa (*i.e.*, actual f.o.b. cost).

BASUTOLAND, BECHUANALAND PROTECTORATE, AND SWAZILAND.—Proclamations dated August 14th provide for the introduction of amendments in the import duties in force similar to those recently made to the Union Customs Tariff by Act No. 37 of 1916—see the REVIEW of September 15th—and have the effect of bringing the Tariffs of these Territories into line with the Union Tariff.

SWEDEN.—Since October 1st the exportation of copper ore and nickel ore has been prohibited by the Swedish authorities.

FRENCH COLONIES.—The provision of the Decree of February 24th last, in virtue of which tungsten ore was allowed to be exported from French Colonies and Protectorates (other than Tunis and Morocco), *without special authorisation*, when consigned to the United Kingdom, the British Dominions, &c., has now been abrogated by a Decree of the Minister for the Colonies.

TUNIS.—By a Decree dated September 8th the importation of various articles of foreign origin, or coming from foreign countries, is prohibited. The list of goods is the same as that prohibited to be imported into France and Algeria by the Decrees of May 11th and July 18th. (The full list was printed in the *Board of Trade Journal* of July 27th and September 14th). The prohibition is, however, not to apply to goods which are proved to have been dispatched to Tunis, or declared for warehousing in that country, prior to the date of publication of the Decree (September 16th). Relaxations of the prohibition may, as an exceptional measure, be authorised under conditions to be fixed by the Tunisian Director-General of Finance. Applications for import licences must be addressed by Tunisian importers to the local authorities.

CHILE.—A translation of the New Customs Tariff Law, to which reference was made in the REVIEW of August 18th, has recently been issued as a Parliamentary Return [Cd. 8,364], copies of which may be purchased (price 1s. ex postage) from the usual sale agents for Government publications. In addition to the translation of the new Law, a translation is included of a series of general rules respecting the application of the Tariff.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & CO., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

14,658. "Electric cables and electric protection schemes." F. B. WHITAKER. October 16th.

14,660. "Sparking plugs." M. FAVERO & H. J. BLANCH. October 16th.

14,663. "Sparking plugs." A. E. TONKS, TONKS & SONS, C. W. TONKS, E. TONKS, G. A. TONKS. October 16th.

14,666. "Telephones." S. SIMPSON. October 16th.

14,670. "Electrical continuous-ringing ship's telegraph alarm." A. M. BOOTH. October 16th.

14,690. "Electrolysing apparatus." R. J. J. MUELLER & THE UNIVERSAL OXYGEN CO. October 16th.

14,699. "Electric welding." S. Z. DE FERRANTI. October 16th.

14,703. "Combined electric lampholder and movable-jointed bracket." H. C. GABELL. October 16th.

14,717. "Therapeutic electrical chair." W. BULLOCK. October 17th.

14,721. "Improving voltage regulations in alternating-current sub-stations, feeders, rotary converters, &c." A. M. TAYLOR. October 17th.

14,739. "Variable magnetic-opposed reaction-coil electric circuit." I. E. ASKE. October 17th.

14,745. "Apparatus for electrocuting animals." A. D. CLARKE & E. G. FAIRHOLME. October 17th.

14,767. "Vacuum-type inverted converters." BRITISH WESTINGHOUSE ELECTRIC & MANUFACTURING CO. October 17th. (U.S.A., November 29th, 1915.)

14,768. "Separators for electric batteries." O. OLDHAM. October 17th.

14,784. "Bayonet cap switch lampholder for electric lamps." P. J. MORRIS. October 18th.

14,807. "Sparking plugs for internal-combustion engines." H. W. F. IPELAND. October 18th.

14,812. "Electrodes for secondary batteries." E. H. NAYLOR & S. F. TYLER. October 18th.

14,819. "Miners', &c., electric battery lamps." F. J. TURQUAND. October 18th

14,825. "Voltage or intensity regulators." A. J. JULLIN. October 18th.

14,827. "Securing internal-combustion engine sparking plugs." SIR W. BEARDMORE & T. C. W. PULLINGER. October 18th.

14,842. "Electrical apparatus controlled from a distance." METROPOLITAN CARRIAGE, WAGON & FINANCE CO., D. K. MORRIS, W. P. TRITTON, AND W. G. WILSON. October 19th.

14,849. "Gland for passing electric cables through bulkheads or decks." J. H. COLLIE. October 19th.

14,859. "Electricity multicore cable dividing boxes or apparatus." R. W. BLADES AND THE BRITISH INSULATED & HELSBY CABLES, LTD. October 19th.

14,886. "Dynamo-electric machines." A. H. MIDGLEY & C. A. VANDERVELL. October 19th.

14,927. "Electrical cut-outs and distributing boards." R. W. BILL. October 20th.

14,930. "Controlling electric arcs." D. F. COMSTOCK. October 20th. (U.S.A., October 20th, 1915.)

14,946. "Magnets for magneto-electric machines." G. F. COOKE. October 20th

14,949. "Transmitting apparatus for electric signalling." S. OULIANINE. October 20th.

14,957. "Electric relays." S. OULIANINE. October 20th.

14,960. "Automatically-controlled relay commutators." S. OULIANINE. October 20th.

14,975. "Conductive hearths for electric furnaces." H. ETCHELLS & H. A. GRAVES. October 17th.

14,983. "Electrical signalling systems." A. W. SHARMAN. October 21st.

15,007. "Electric motor controllers, &c." J. ANDERSON & G. ELLISON. October 21st.

15,008. "Apparatus for regulating voltage of dynamos." A. J. JULLIN. October 21st. (France, June 9th, 1914.)

15,009. "Apparatus for regulating voltage of dynamos." A. J. JULLIN. October 21st. (France, June 16th, 1914.)

15,010. "Apparatus for regulating voltage of dynamos." A. J. JULLIN. October 21st. (France, July 28th, 1914.)

PUBLISHED SPECIFICATIONS.

1915.

13,568. MEANS FOR MINIMISING SPARKING AT BREAK OF A CIRCUIT CONTAINING INDUCTANCE AND CAPACITY IN SERIES. T. F. Wall. September 24th.

13,806. ELECTRIC BELLS AND THE LIKE. R. E. H. Lovelace, C. E. Ford and Edison & Swan United Electric Light Co. September 28th.

13,904. HIGH-FREQUENCY DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). September 30th.

13,912. ELECTRO-MAGNETIC POWER TRANSMISSION APPARATUS. A. H. Neuland. September 30th.

14,047. SAFETY ATTACHMENT FOR SYNCHRONISERS. P. E. Means. October 4th

14,160. DYNAMO-ELECTRIC MACHINES. A. H. Neuland. October 6th.

14,216. DYNAMO-ELECTRIC MACHINES OF THE COMMUTATOR TYPE. M. Walker. October 7th.

14,232. PORTABLE TELEPHONE AND TELEGRAPH INSTRUMENTS. International Electric Co., Ltd., and R. G. le Noir. October 7th.

14,233. TELEPHONES. International Electric Co., Ltd., and R. G. le Noir. October 7th.

14,650. ALTERNATING-CURRENT ELECTRIC MOTORS. J. G. Shaw, C. R. Shaw and H. G. Sharp. October 16th.

15,143. PRESSURE DIE FOR INSULATOR PRESSING MOULDS. P. Simonsen. October 26th. (November 17th, 1914.)

16,721. VEHICLES. British Thomson-Houston Co. (General Electric Co., U.S.A.). November 26th.

17,533. ELECTRICAL INDICATING DEVICES TO BE USED ON TAXI-CABS AND THE LIKE. H. Richardson & H. E. Gill. December 15th. (Cognate application, 6,095/16.)

17,833. SYSTEMS OF ELECTRIC WELDING. D. H. Wilson, J. M. Andersen and K. L. Curtis. December 31st. (December 31st, 1914, U.S.A.)

1916.

The numbers in brackets are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

894. CURRENT LIMITERS OR ELECTRIC INTERRUPTERS. K. Pettersen. January 30th, 1915. [100,048.]

4,413. ELECTRIC FLASH-LAMP ATTACHMENTS. T. Y. Unwin & British Ever-Ready Co. March 24th. [101,585.]

5,240. SPARKING PLUGS. A. E. Lamkin. April 10th. [101,592.]

5,673. RAILWAY SIGNALLING APPARATUS. J. P. O'Donnell. April 18th, 1916. [101,595.]

6,735. ELECTROLYTIC CELLS. C. Churchill & Co. and E. Geeraerd. May 11th, 1916. [101,598.]

7,347. MEANS FOR EARTHING ELECTRIC CONDUCTOR CONDUITS. G. Rushton and L. R. Lacy. May 23rd, 1916. [101,604.]

8,521. FITTINGS FOR PREVENTING THEFT OF ELECTRIC INCANDESCENT LAMPS. J. Harrington. June 16th. [101,607.]

8,577. RAILWAY SIGNALLING APPARATUS. J. P. O'Donnell & H. S. Knox. June 17th, 1916. (Addition to 8,398/15.) [101,608.]

8,698. METHOD AND APPARATUS FOR VARYING THE PRESSURE IN ELECTRO-MAGNETICALLY-OPERATED CARBON PRESSURE REGULATORS. Akt. Ges. Brown, Boveri et Cie. June 25th, 1915. [100,788.]

9,745. ELECTRIC COUPLINGS. Allmanna Svenska Elektriska Aktiebolaget. July 21st, 1915. [100,948.]

10,554. ELECTRIC CABLE JOINT BOXES. C. Vernier. [101,614.]

11,658. MEANS FOR TELEPHONIC COMMUNICATION TO AND FROM MOVING RAILWAY TRAINS AND THE LIKE. V. G. Werner & K. H. Warfvinge. August 27th, 1915. [101,343.]

British Trade with Canada.—The Ottawa correspondent of the *Morning Post* states that Mr. O'Hara, Deputy Minister of Commerce for the Dominion, giving evidence at the sitting of the Royal Commission, said that the sale of British-made goods was not pushed with sufficient vigour in Canada, whereas American exporters advertised widely, besides having the advantage of reports as to trade openings for American goods all over the Dominion. He suggested that the British Trade Commission service should be extended throughout Canada, representatives being appointed in all the large centres. Further, he recommended that the sister Dominions should also send trade agents to Canada.